

Steering Control Units—Series 40

Product Description and Features

The Series 40 steering control unit includes two patented designs that make it even more responsive, reliable and cost effective.

- Symmetrical valving provides passageways and valving that are equal in both directions and pressure areas that are staged for minimum leakage. This gives balance, precise servo response and uniform steering action in both directions.
- Progressive valving makes it possible to produce the spool/sleeve valve in a way that assures reliability and reduces costs.

Eaton®'s high capacity gerotor assembly provides a lot of capacity in a small package.

Heavier valve components—housing, spool and sleeve—provide stability, especially during pressure and thermal transient conditions.

The seal and centering spring designs provide positive, low-effort steering feel assuring excellent vehicle control, an important feature on large vehicles for which this steering control was designed.

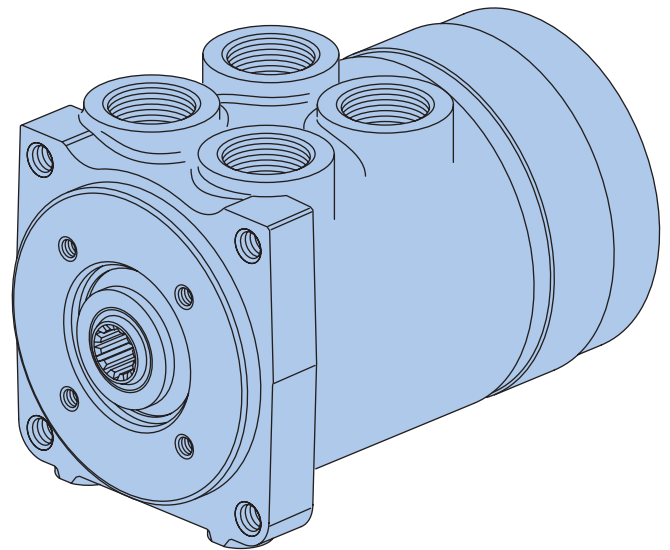
Features

- Open Center
- Closed Center
- Load Sensing
- Q-amp
- Pilot Pressure Port*

*This is an added feature that can be used for...
1)pilot pressure to priority valve.
2)diagnostics.

Applications Articulated Vehicles

- Loaders
- Scrapers Frame Vehicles
- Large Front End Loaders
- Large Graders
- Mining Trucks
- Articulated Haulers
- Transporters



SPECIFICATIONS

Max. System Pressure	241 bar [3500 PSI]
Max. Back Pressure	21 bar [300 PSI]
Rated Flow	151 l/min [40 GPM]
Max. Flow	212 l/min [56 GPM]
Max. System Operating Temperature	93°C [200° F]
Max. Differential Between Steering Unit and System Temperature	28° C 50° F
Input Torque Powered	2,8-3,4 Nm @ 6,9 bar back pressure [25-30 lb-in @ 100 PSI back pressure]
Non Powered	†††
Rotation Limits	None
Fluid	ATF Type A and most petroleum based fluids
Recommended Filtration	ISO 18/13 cleanliness level

††† Manual steering is **not** possible without hydraulic power.

Char-Lynn® steering control units are covered by one or more of the following U.S. Patents 4,033,377 and 4,109,679. Corresponding foreign patents pending and issued.

Steering Control Units—Series 40

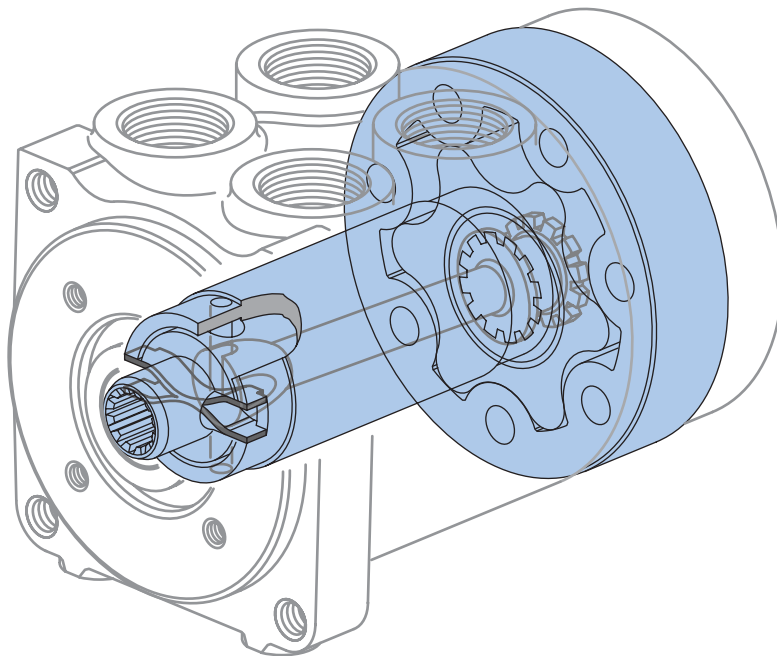
Standard Product Releases

SERIES 40

System	Signal	Load Circuit	Rated Flow l/min [GPM]	O-ring Port Size	Actual Displacement cm ³ /r [in ³ /r]—Product Number				
					1230 [75]	1555 [95]	1965 [120]	2460 [150]	3030 [185]
Open Center	N/A	Non Load Reaction [40]	151 [40]	1 5/16-12	281-1001	281-1002	281-1003	281-1004	281-1005
Closed Center	N/A	Non Load Reaction [40]	151 [40]	1 5/16-12	282-1010	282-1011	282-1012	282-1013	282-1014
				1 5/16-12	282-1001**	282-1002**	282-1003**	282-1004**	282-1005**
Load Sensing	Dynamic	Non Load Reaction [40]	151 [40]	1 5/16-12	283-1001	283-1002	283-1003	283-1004	283-1005

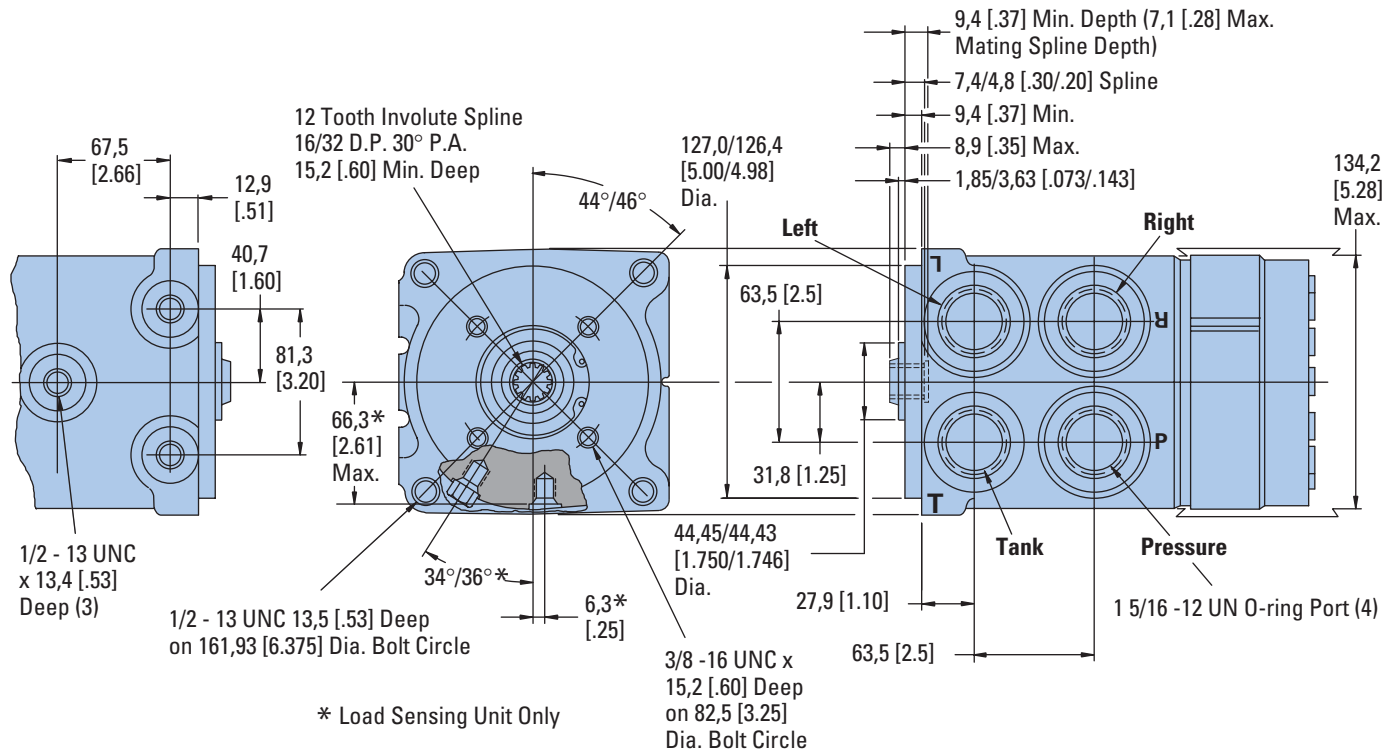
**Closed center units with neutral bleed 2,3 l/min [.6 GPM] at 172 bar [2500 PSI] (see page 7).

Example: 281-1001-002
 |
 Product Number Design Code

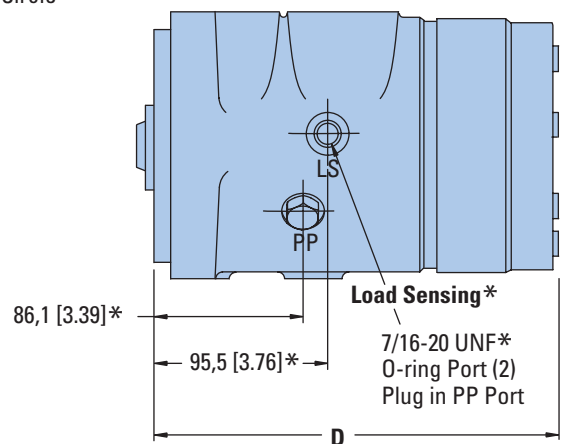


Steering Control Units—Series 40

Installation Drawing



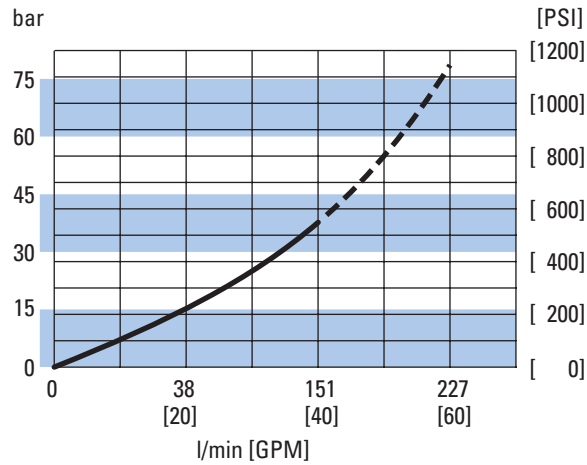
Displacement cm ³ /r [in ³ /r]	D Max. mm [in.]
1230 [75]	230,9 [9.09]
1555 [95]	245,9 [9.68]
1965 [120]	265,2 [10.44]
2460 [150]	288,3 [11.35]
3030 [185]	315,0 [12.40]



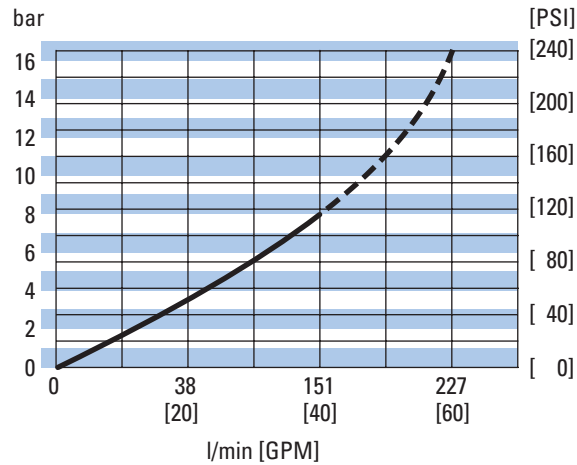
Steering Control Units—Series 40

Performance Data

Average Pressure Drop Through Open Center Load Sensing and Closed Center at Full Valve Deflection



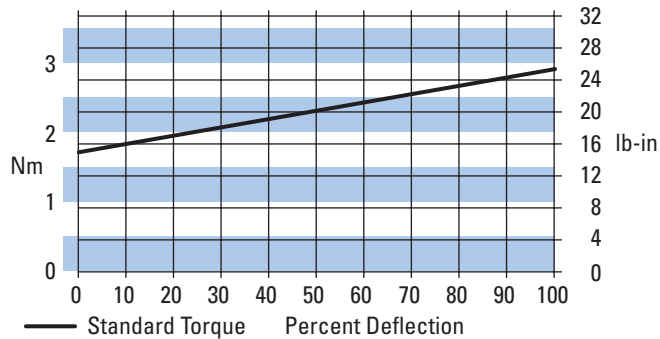
Open Center Neutral Pressure Drop Fluid Viscosity 25 cSt [120 SUS]



Input Torque

Applications

- Articulated and Rigid Dump Trucks
- Mining Trucks
- Paving Equipment



Steering Control Units—Series 40

Model Code – Ordering Information

The following 29-digit coding system has been developed to identify all of the configuration options for the Series 40 steering control units. Use this model code to specify a unit with the desired features. All 29 digits of the code must be present when ordering. You may want to photocopy the matrix below to ensure that each number is entered in the correct box.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
A	B	Y		6	A						0	0	0	0	0	0					3	A	0	0	0	0	0	B

Nos	Feature	Code	Description	Nos	Feature	Code	Description
1,2,3	Product Series	ABY	Series 40 Steering Control Unit	18,19,20,21	Ports and Mounting Threads	GAAA	4 x 1 – 5/16 SAE Ports with 3/8-16 UNC Column Mounting Threads
4	Nominal Flow Rating	8	151 l/min [40 GPM]				
		9	227 l/min [60 GPM] (Q-amp only)				
5	Inlet Pressure Rating	6	241 bar [3500 PSI]			GAGA	4 x 1 – 5/16 SAE ports with 7/16 SAE Load Sensing Port and 7/16 SAE Pilot Pressure Port with 3/8-16 UNC Column Mounting Threads (Use with Load Sensing Only)
6	Return Pressure Rating	B	21 bar [300 PSI]	22	Input Torque	3	Standard
7-8	Displacement cm ³ /r [in ³ /r]	71	1230 [75]	23	Fluid Type	A	See Eaton Technical Bulletin 3-401
		74	1560 [95]	24	Special Applications	0	None
		76	1970 [120]	25,26	Special Features	00	None
		78	2460 [150]	27	Paint	0	No Paint
		80	3030 [185]	28	Identification	0	Eaton Product Number on Nameplate
9	Flow Amplification	0	None	29	Eaton Assigned Design Code	B	Assigned Design Code
		1	1.6 : 1.0 Ratio				
10	Neutral Circuit	A	Open Center				
		C	Closed Center				
		D	Closed Center with Neutral Bleed				
		F	Load Sensing, Dynamic Signal				
11	Load Circuit	A	Non-Load Reaction				
		E	Non-Load Reaction, Cylinder Damping (Use with Q-amp only)				
12,13	Integral Valve	00	None				
14,15	Integral Inlet Relief Valve Pressure Setting	00	None				
16,17	Cylinder Relief Valve Setting	00	None				

Torque Generator

Product Description

Char-Lynn® torque generators have been completely redesigned to meet the needs of the changing marketplace. These torque generators provide power assist for steering, eliminating the large hand wheels on gate valves, and provide powerful rotary motion with effortless manual rotary input on numerous other applications.

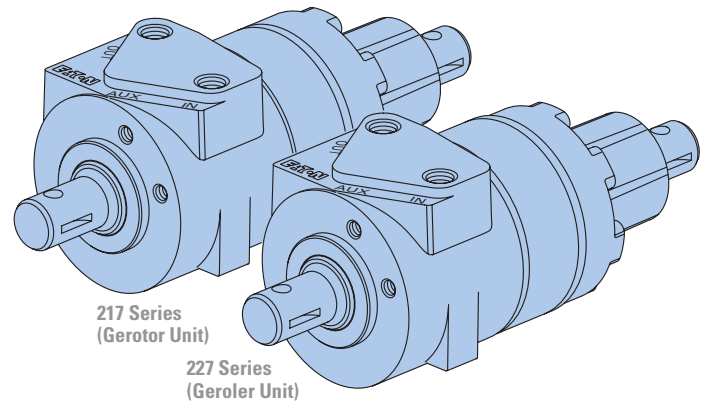
Features

Today's market includes power steering on electric lift trucks. Char-Lynn torque generators have been designed with features that greatly improve the operator's comfort as well as the vehicle's performance.

The increase in port surface area allows for the additional port requirement for units with the following features:

Power Beyond

This version has three ports: Inlet (IN), Tank (OUT), and Excess Flow (EF). In the power beyond configuration, flow not used for priority steering exiting the EF port and is available for the downstream reach function. Flow used for steering will exit the (OUT) port to tank, and cannot be used for auxiliary functions.



Load Sensing

Char-Lynn load sensing torque generators use conventional or load sensing power supplies to achieve load sensing steering. The use of a load sensing torque generator and a priority valve in a normal power steering circuit offers the following advantages:

- Provides smooth pressure compensated steering because load variations in the steering circuit do not affect axle response or maximum steering rate.
- Provides true power beyond system capability by splitting the system into two independent circuits. Only the flow required by the steering maneuver goes to the steering circuit. Flow not required for steering is available for use in the auxiliary circuits.
- Provides reliable operation because the steering circuit always has flow and pressure priority.

Char-Lynn load sensing torque generators and priority valves can be used with open center, closed center or load sensing systems. Used either in an open center system with a fixed displacement pump or a closed center system with a pressure compensated pump, these torque generators offer many of the features of a load sensing system. Excess flow is available for auxiliary circuits.

Torque Generator

Product Description

Continued

Open Center with Case Drain

This high pressure open center torque generator allows the exit flow from the Torque Generator to operate another function (for example reach/tilt function of a fork lift vehicle). An external case drain is needed to protect seals and to allow for adequate recentering of spool and sleeve. The flow out the case drain is internal leakage only. This is a series circuit with some special characteristics that should be noted:

- A relief valve is required in the down stream circuit as well as a relief valve protecting the torque generator.
- The pressures in this circuit are additive. If it takes 41 bar [600 PSI] for steering and 55 bar [800 PSI] for the reach circuit, the pump will see 96 bar [1400 PSI].
- The relief valve for steering must always be set higher than the relief valve on the downstream function (reach). The margin between the two must be enough to provide adequate steering in the worst case (fork lift stationary and unloaded).

Anti-Friction Needle Bearings

Torque generators are available with anti-friction needle bearings at the power end to allow for direct mount sprockets or pinions when compactness of application does not allow for outboard bearings.

Gerotor or Geroler® Element

This is a fluid displacement element, consisting of an outer ring gear and an internal star. Manual low torque input actuates the spool of the spring centered spool and sleeve valve, allowing high pressure oil to turn the internal star. This star is coupled with a splined drive to the output shaft and also the sleeve of the spool and sleeve valve. High pressure oil turning the star in this gerotor or Geroler element is generating high output torque.

The Geroler elements have not been offered on torque generators in the past. These Gerolers have rolls incorporated into the outer ring, and the rolls provide rolling contact with the star point, minimizing friction and improving efficiency.

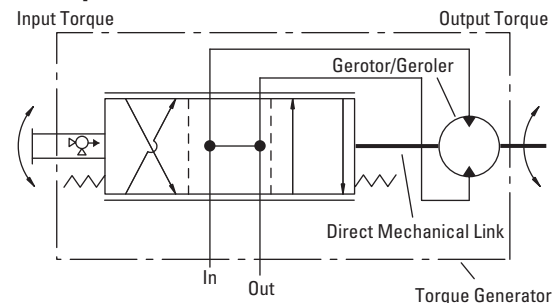
Limited Manual Steering

Relative deflection of the input and output shafts is limited mechanically within the unit so that limited manual steering is still possible in the event of power loss.

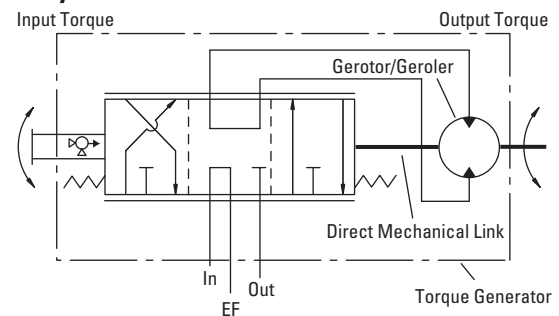
Reaction Torque Resistance

Customer supplied bracket is required for reaction torque resistance.

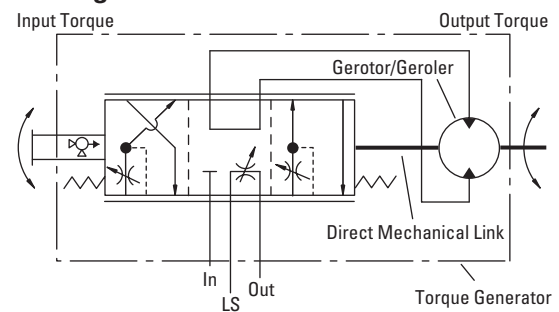
Standard Open Center



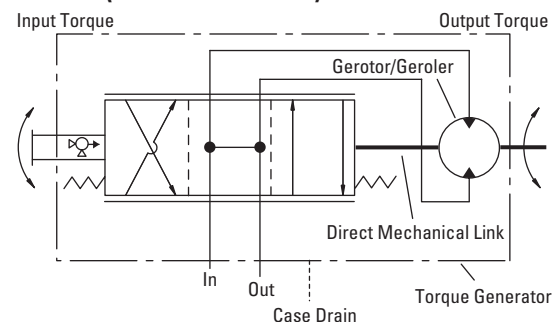
Power Beyond



Load Sensing

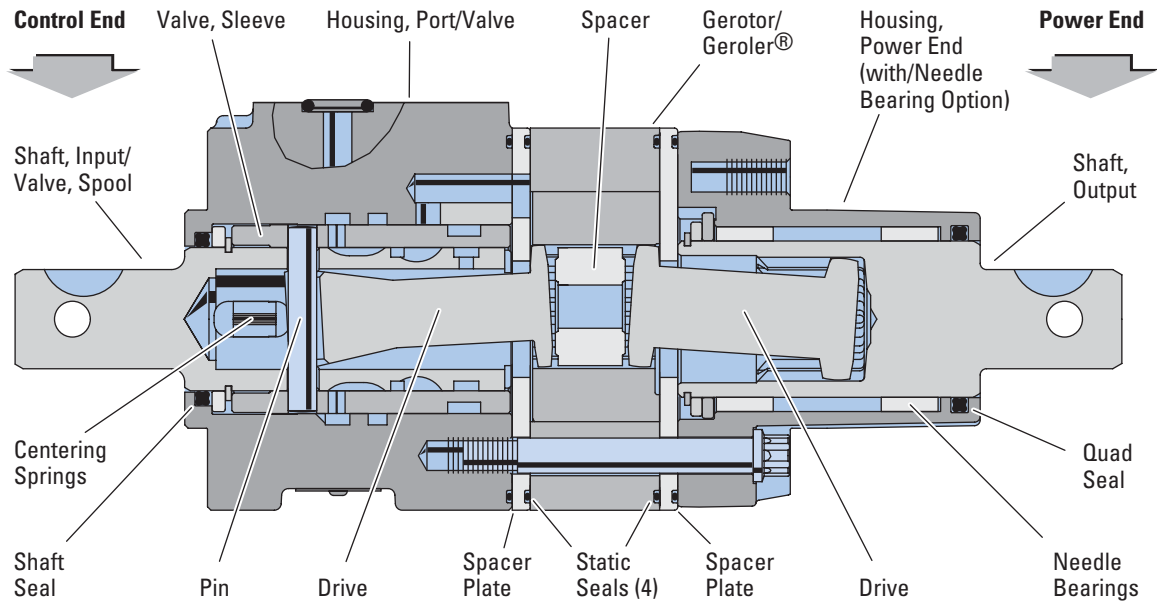


Open Center (with Case Drain)



Torque Generator

Product Information



SPECIFICATIONS 217 SERIES—GEROTOR UNIT

Displacement cm ³ /r [in ³ /r]	76 [4.7]	96 [5.9]	160 [9.7]
Torque Output (at 70 bar [1000 PSI])	62 Nm [550 lb-in]	79 Nm [700 lb-in]	124 Nm [1100 lb-in]
Recommended Flow	11,4 l/min [3 GPM]	13,2 l/min [3.5 GPM]	13,9 l/min [5 GPM]
Max. Operating Speed (at Rated Pressure and Recommended Flow)	125 RPM	118 RPM	102 RPM

SPECIFICATIONS 227 SERIES—GEROLER® UNIT

Displacement cm ³ /r [in ³ /r]	80 [4.9]	102 [6.2]	160 [9.7]
Torque Output (at 70 bar [1000 PSI])	69 Nm [608 lb-in]	86 Nm [760 lb-in]	131 Nm [1160 lb-in]
Recommended Flow	11,7 l/min [3.1 GPM]	15,1 l/min [4 GPM]	18,9 l/min [5 GPM]
Max. Operating Speed (at Rated Pressure and Recommended Flow)	125 RPM	118 RPM	102 RPM

COMMON SPECIFICATIONS 217 AND 227 SERIES

Rated Flow	15,1 l/min [4 GPM]
Max. System Operating Temperature	93° C [200° F]
Input Torque Powered	1,6 - 2,5 Nm [14 - 22 lb-in]
Non-Powered (Max.)	136 Nm [100 lb-ft]
Output Shaft Side Load at Keyway Centerline	
without Bearing	23 kg [50 lb]
with Bearing	272 kg [600 lb]
Fluid	Most petroleum hydraulic fluids—see your Eaton representative for use of fire-resistant and other special fluids
Recommended Filtration	As needed to maintain ISO 18/13 cleanliness level
Rated Pressure	Depends on model—See chart circuit type below

Circuit Type	In Port	Out Port	Aux. Port	Max. In minus Out
Open Center	69 bar [1000 PSI]	3 bar [50 PSI]	—	—
Power Beyond	138 bar [2000 PSI]	3 bar [50 PSI]	138 bar [2000 PSI]	69 bar [1000 PSI]
Load Sensing	69 bar [1000 PSI]	3 bar [50 PSI]	69 bar [1000 PSI]	—
Open Center w/Case Drain	172 bar [2500 PSI]	103 bar [1500 PSI]	3 bar [50 PSI]	69 bar [1000 PSI]

Torque Generator

Product Information

Continued

217 SERIES—GEROTOR UNIT

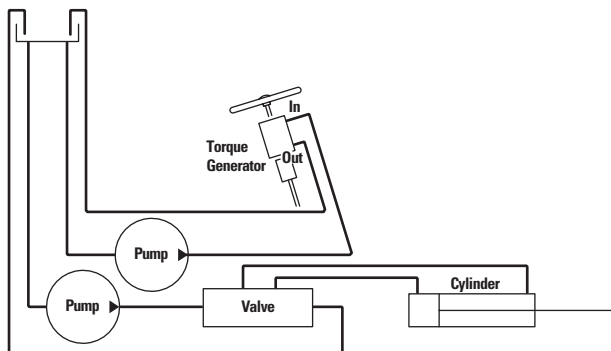
Feature	Ports	Circuit Type	Displacement cm ³ /r [in ³ /r]	Product Number
Machined Mounting			76 [4.7]	217-1049
Faces	9/16-18	Open	95 [5.9]	217-1050
Each End	O-ring	Center	160 [9.7]	217-1048
Machined Mounting			76 [4.7]	217-1030
Faces	Manifold	Open	95 [5.9]	217-1015
Each End		Center	160 [9.7]	217-1020
Power End w/Bearing and			76 [4.7]	217-1051
Machined Faces	Manifold	Open	95 [5.9]	217-1028
		Center	160 [9.7]	217-1052

227 SERIES—GEROLER® UNIT

Feature	Ports	Circuit Type	Displacement cm ³ /r [in ³ /r]	Product Number
Machined Mounting			80 [4.9]	227-1049
Faces	9/16-18	Open	102 [6.2]	227-1050
Each End	O-ring	Center	160 [9.7]	227-1048
Machined Mounting			80 [4.9]	227-1030
Faces	Manifold	Open	102 [6.2]	227-1015
Each End		Center	160 [9.7]	227-1020
Power End w/Bearing and			80 [4.9]	227-1051
Machined Faces	Manifold	Open	102 [6.2]	227-1028
		Center	160 [9.7]	227-1052

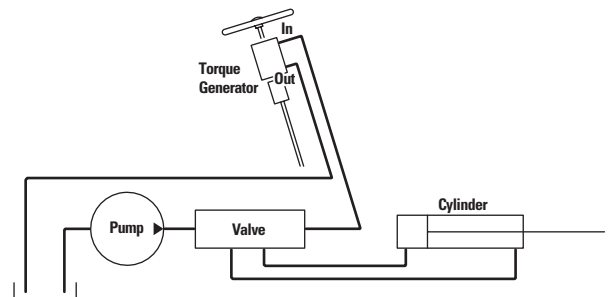
Example: 217-1049-002
 Product Number Design Code

Circuits for Torque Generator—Conventional Systems



Conventional System with Two Pumps

- Extra cost of two separate circuits



Conventional System with One Pump

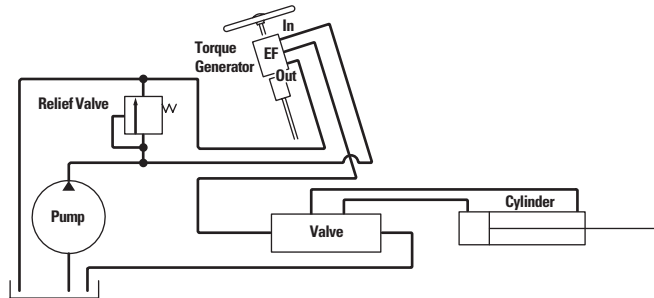
- Can result in insufficient steering flow when operating the auxiliary function

Circuits for Torque Generator—

Conventional Systems Continued

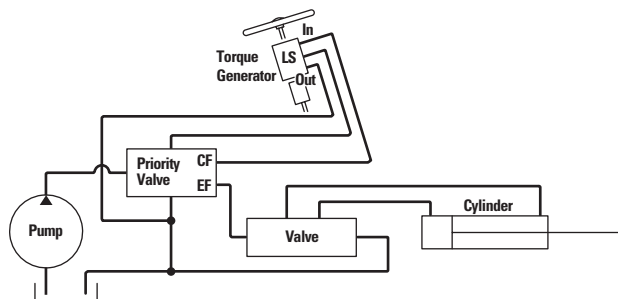
Power Beyond Torque Generator

- Parallel circuit
- Steering has priority
- Simple system
- Single relief valve
- Flow to auxiliary function is reduced while steering



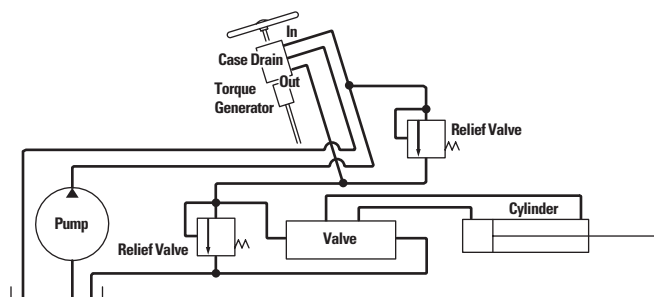
Load Sensing System

- Steering has priority
- Auxiliary function can operate at higher pressure than steering rating; priority valve isolates CF side from EF side pressures.
- Flow to auxiliary functions reduced while steering



High Back Pressure Torque Generator

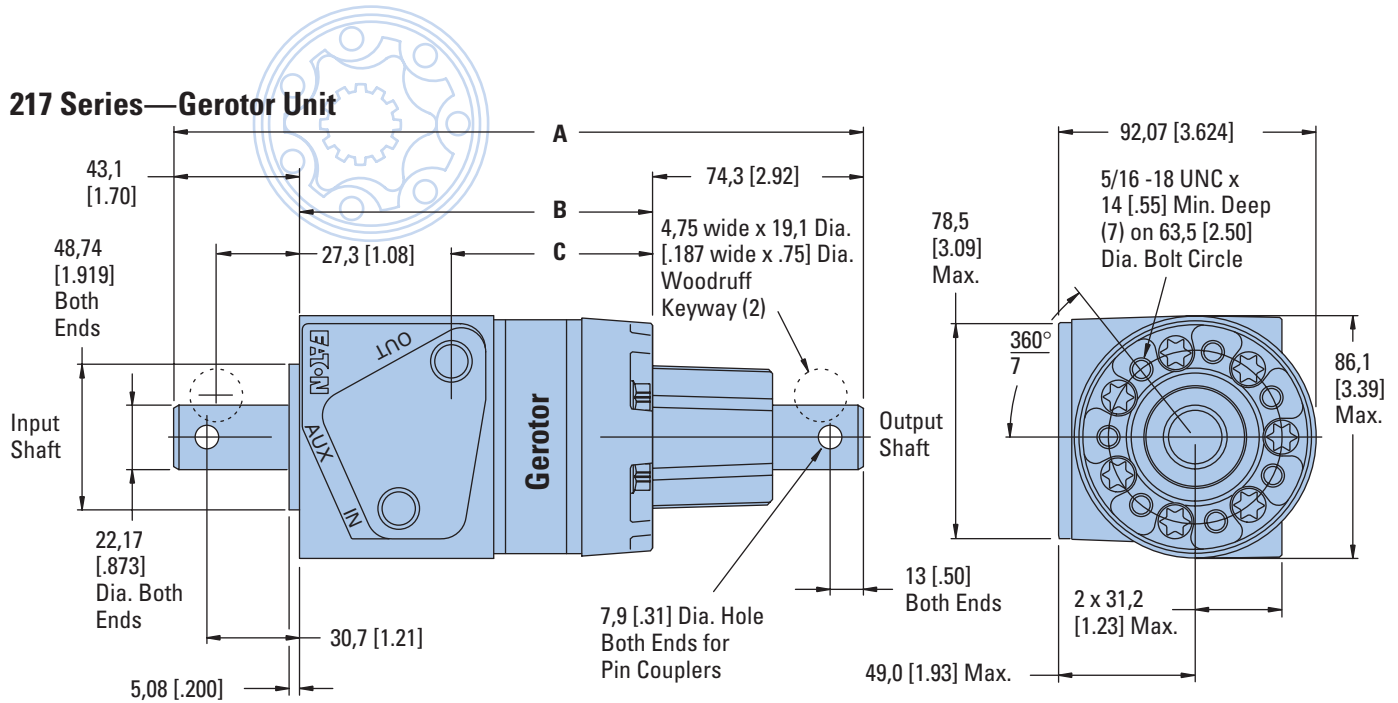
- Series circuit; auxiliary and steering pressures are additive
- All flow available to auxiliary function, even while steering
- Separate relief valves required for steering and auxiliary



Torque Generator

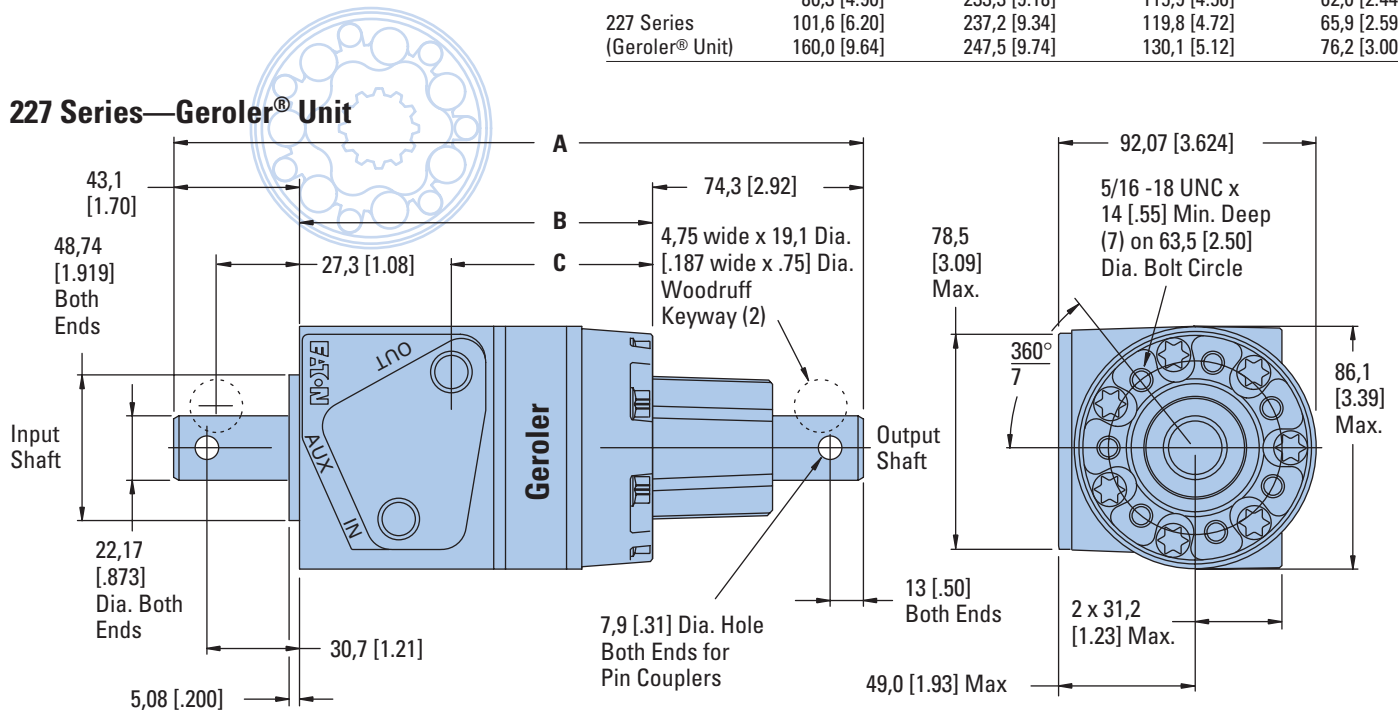
Installation Drawing

217 Series—Gerotor Unit



	Displacement cm ³ /r [in ³ /r]	Dimension mm [inch]		
		A	B	C
217 Series (Gerotor Unit)	96,1 [5.86]	231,9 [9.13]	114,5 [4.51]	60,4 [2.38]
	159,6 [9.73]	240,6 [9.47]	123,2 [4.85]	69,3 [2.73]
227 Series (Geroler® Unit)	80,3 [4.90]	233,3 [9.18]	115,9 [4.56]	62,0 [2.44]
	101,6 [6.20]	237,2 [9.34]	119,8 [4.72]	65,9 [2.59]
	160,0 [9.64]	247,5 [9.74]	130,1 [5.12]	76,2 [3.00]

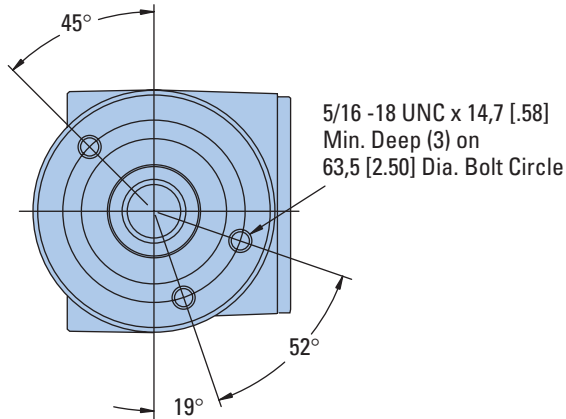
227 Series—Geroler® Unit



Torque Generator

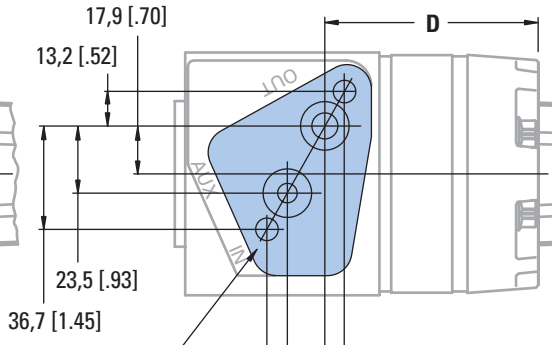
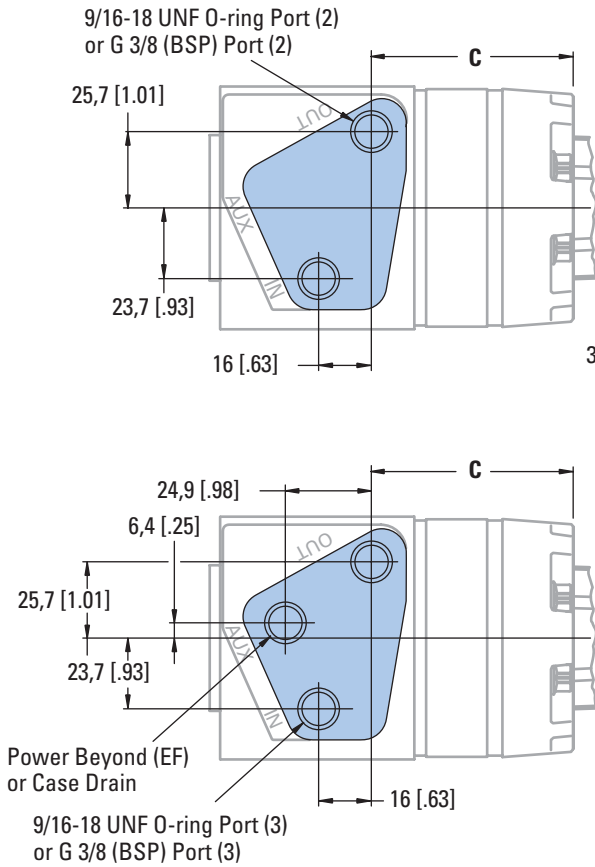
Ports

Input End

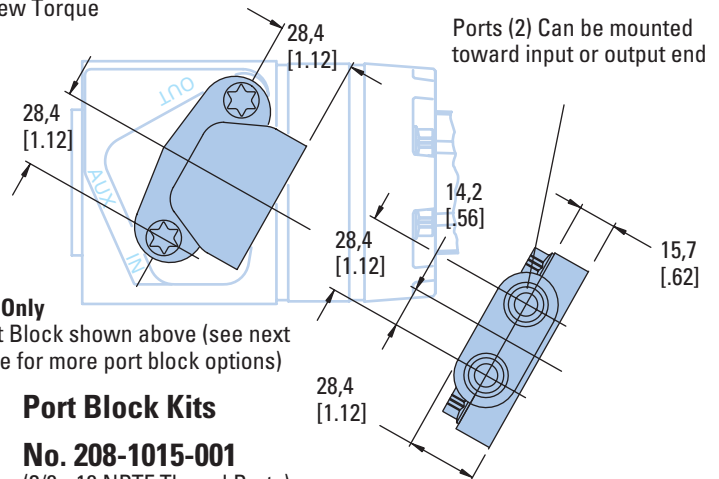


	Displacement cm ³ /r [in ³ /r]	Dimension mm [inch]	
		C	D
217 Series (Geroler® Unit)	96,1 [5.86] 159,6 [9.73]	60,4 [2.38] 69,3 [2.73]	63,5 [2.50] 72,1 [2.84]
227 Series (Gerotor Unit)	80,3 [4.90] 101,6 [6.20] 160,0 [9.64]	62,0 [2.44] 65,9 [2.59] 76,2 [3.00]	

Port Options



217 Only
Manifold Mount
5/16-18 UNC
Mounting Holes (2)
17-21 Nm
[150-190 lb-in]
Screw Torque



217 Only
Port Block shown above (see next page for more port block options)

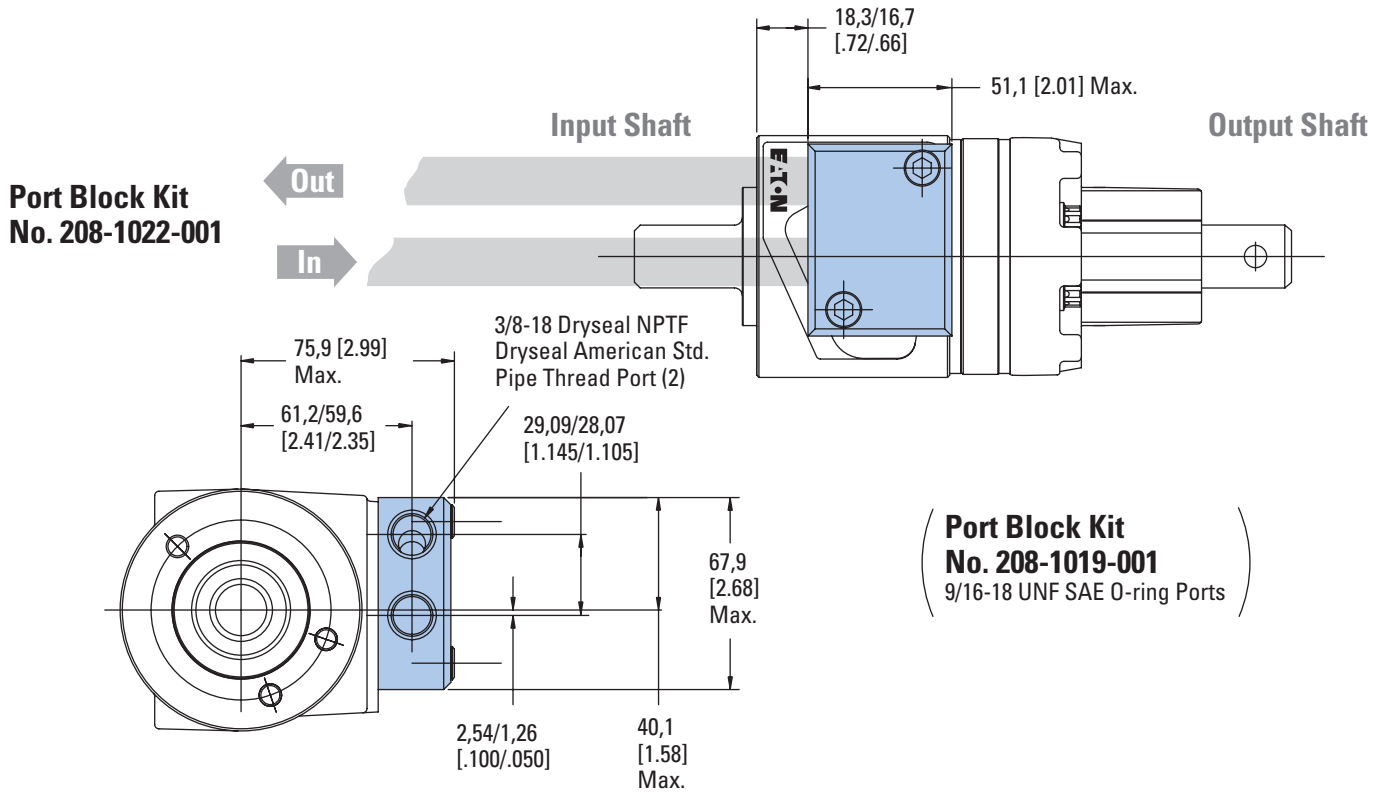
Port Block Kits

No. 208-1015-001
(3/8 - 18 NPTF Thread Ports)

For proper operation it is recommended that the unit be installed so no radial load or thrust load is applied to either the input or output shafts. Misalignment of shafts will cause binding.

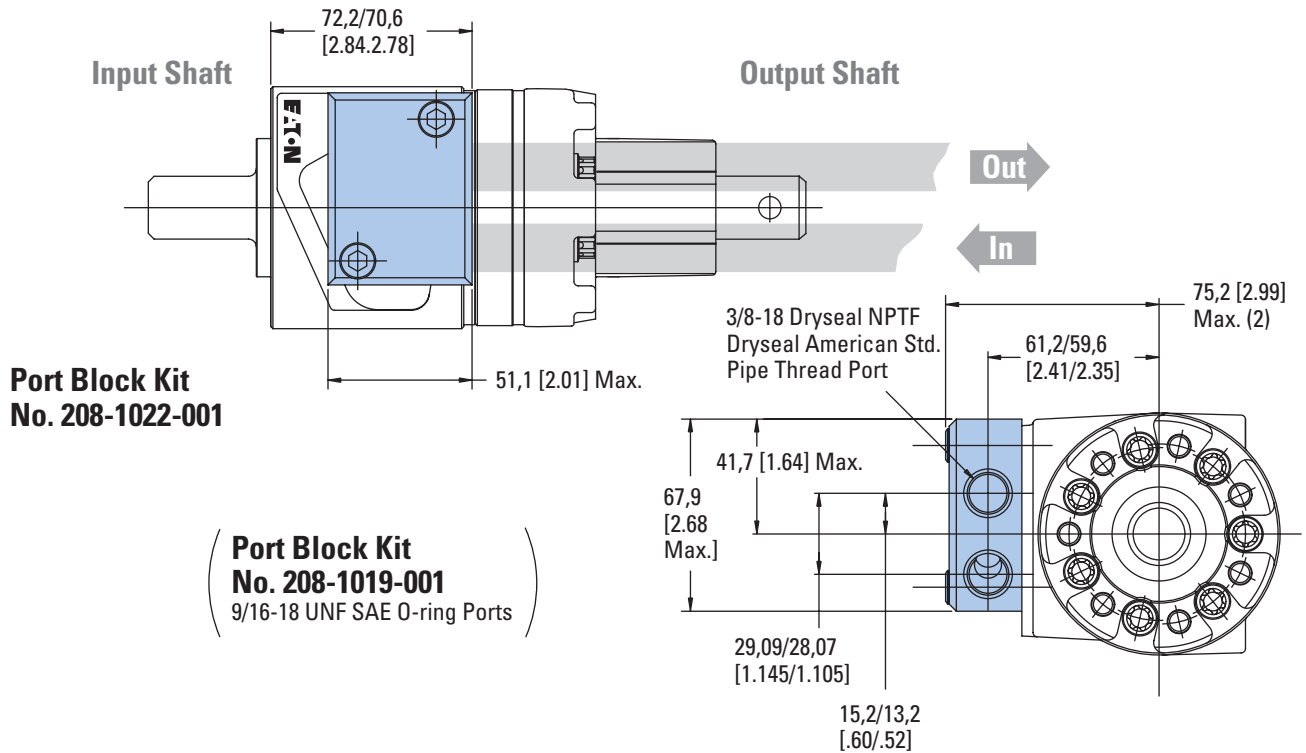
Torque Generator— 217 Series Port Block

Installation Drawing
Port Block with 3/8-18
Dryseal NPTF Ports



Torque Generator— 217 Series Port Block

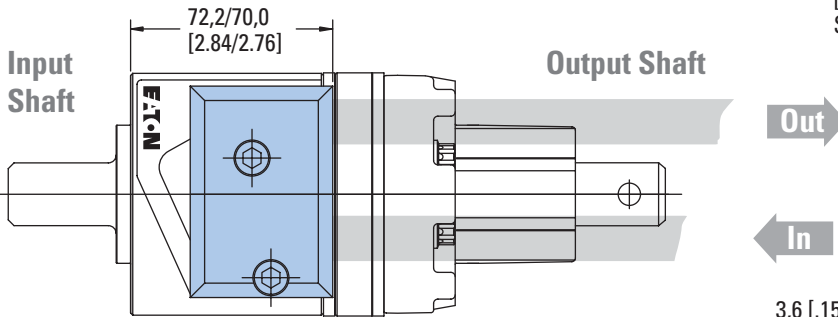
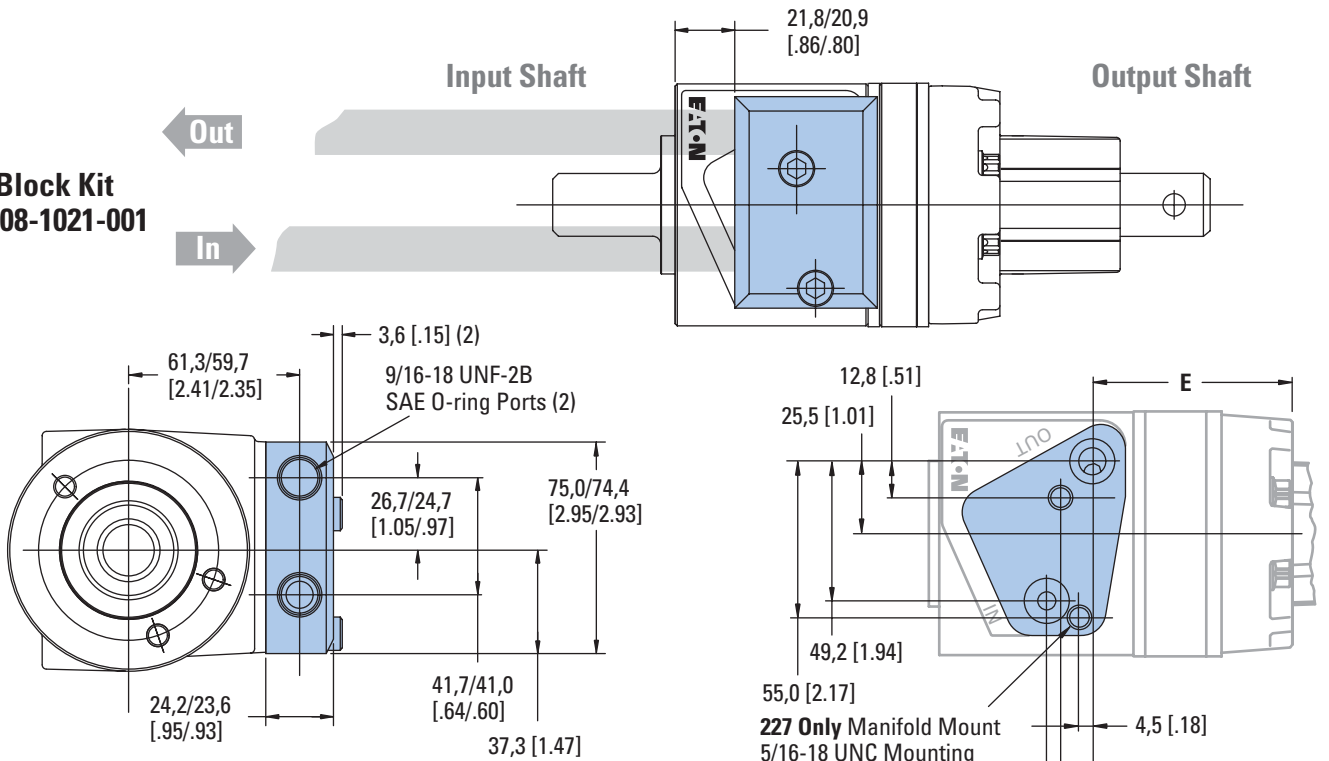
Installation Drawing
Port Block with 3/8-18
Dryseal NPTF Ports



Torque Generator— 227 Series Port Blocks

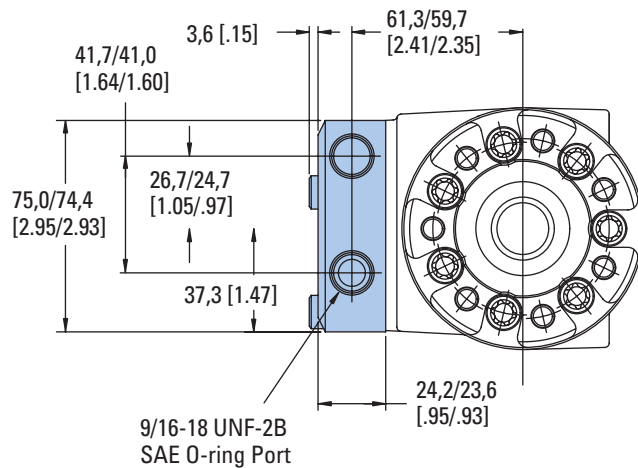
Installation Drawing
9/16-18 UNF SAE
O-ring Port

Port Block Kit
No. 208-1021-001



Displacement cm ³ /r [in ³ /r]	Dim. mm [inch]	
	E	
227 Series	80,3 [4.90]	62,0 [2.44]
(Geroler® Unit)	101,6 [6.20]	71,2 [2.80]
	160,0 [9.64]	76,2 [3.00]

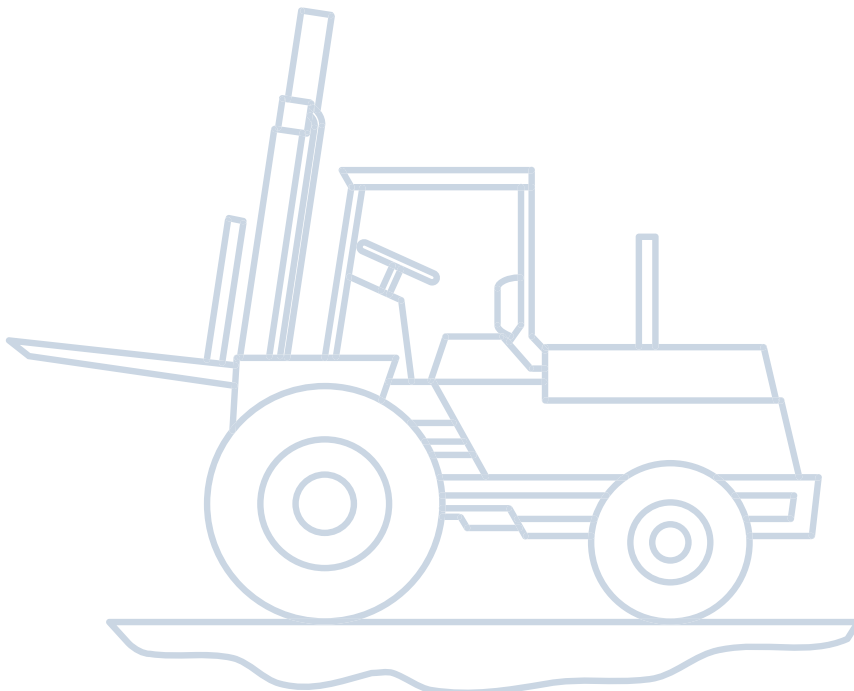
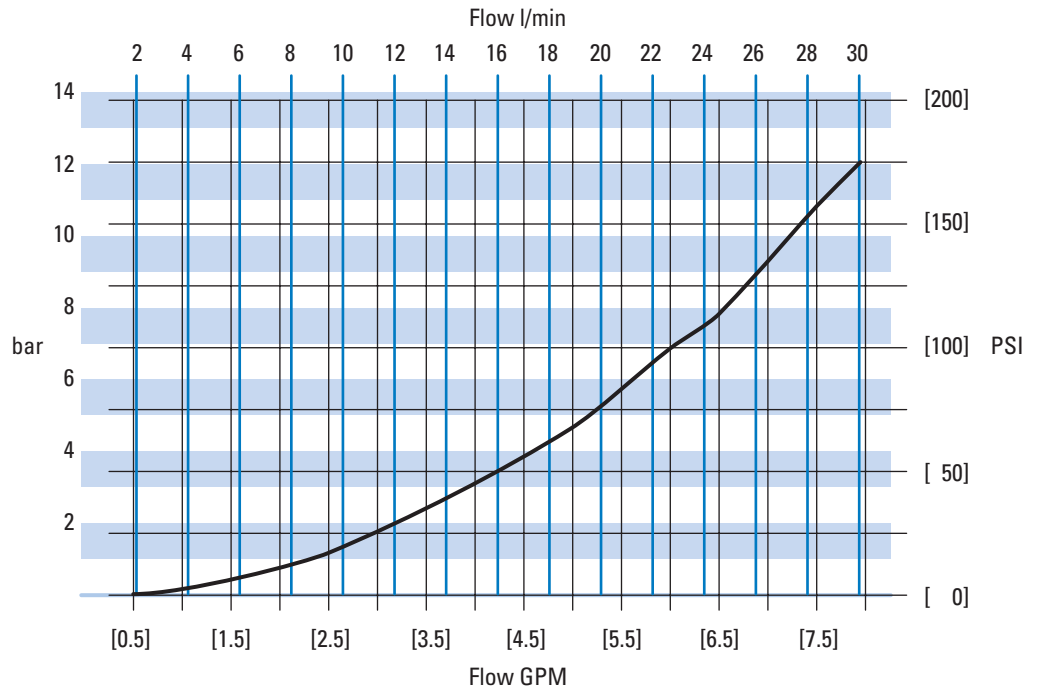
Port Block Kit
No. 208-1020-001



Torque Generator

Performance Data

Torque Generator Pressure Drop



Torque Generator

Model Code

Ordering

Information

The following 20-digit coding system has been developed to identify all of the configuration options for the torque generator. Use this model code to specify a torque generator with the desired features. All 20 digits of the code must be present when ordering. You may want to photocopy the matrix below to ensure that each number is entered in the correct box.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	B	P								0	1	A	1	A			A	1	B

Nos	Feature	Code	Description	Nos	Feature	Code	Description	
1,2,3	Product Series	ABP	Torque Generator	9	Ports	A	2 x .625 inch Dia. Manifold Ports with 2 x 5/16-18 UNC Mounting Holes (use with port block) - open center only	
4,5,6	Circuit Type . and Ratings —Max	A4A	15,1 l/min [4 GPM] Open Center Inlet 69 bar [1000 PSI] Out 3 bar [50 PSI]			B	3 x .625 inch Dia. Manifold Ports with 3 x 5/16 - 18 UNC Mounting Holes (use with port block)	
		D4C	15,1 l/min [4 GPM] Open Center Power Beyond Inlet 138 bar [2000 PSI] Out 3 bar [50 PSI] Aux. (PB) 138 bar [2000 PSI] Dp (Inlet - out) <69 bar [1000 PSI] (Limited to 76 [4.7], 80 [4.9], 96 [5.9] cm ³ /r [in ³ /r])			C	2 x 9/16 SAE Ports—open center only	
						D	3 x 9/16 SAE Ports	
						E	2 x G3/8 (BSP) Ports—open center only	
						F	3 x G3/8 (BSP) Ports	
		E4B	15,1 l/min [4 GPM] Open Center with High Back Pressure (Case Drain) Inlet 172 bar [2500 PSI] Out 103 bar [1500 PSI] Aux. (CD) 3 bar [50 PSI] Dp (Inlet - out) <69 bar [1000 PSI]			10	Shaft Bearings	0 None 1 Output Shaft Needle Bearings
						11	Integral Valves	0 None
						12	Input Torque	1 Standard
						13	Shaft Ends	A 22,17 [.874] Dia. with Keyway and Cross Hole
						14	Shaft Seals	1 Quad Rings
				15	Mounting Threads	A 5/16-18 UNC		
7,8	Displacement cm ³ /r [in ³ /r]	08	76 [4.7] Gerotor	16,17	Special Feature	00 None 01 Port Block Installed		
		10	96 [5.9] Gerotor					
		17	160 [9.7] Gerotor	18	Paint and Packaging	A Black Primer		
		58	80 [4.9] Gerotor					
		60	102 [6.2] Gerotor	19	Identification	1 Eaton Product Number on Nameplate		
		66	160 [9.6] Gerotor	20	Eaton Assigned Design Code	B Assigned Design Code		

Steering System Components

VLC In-Line Priority Valves

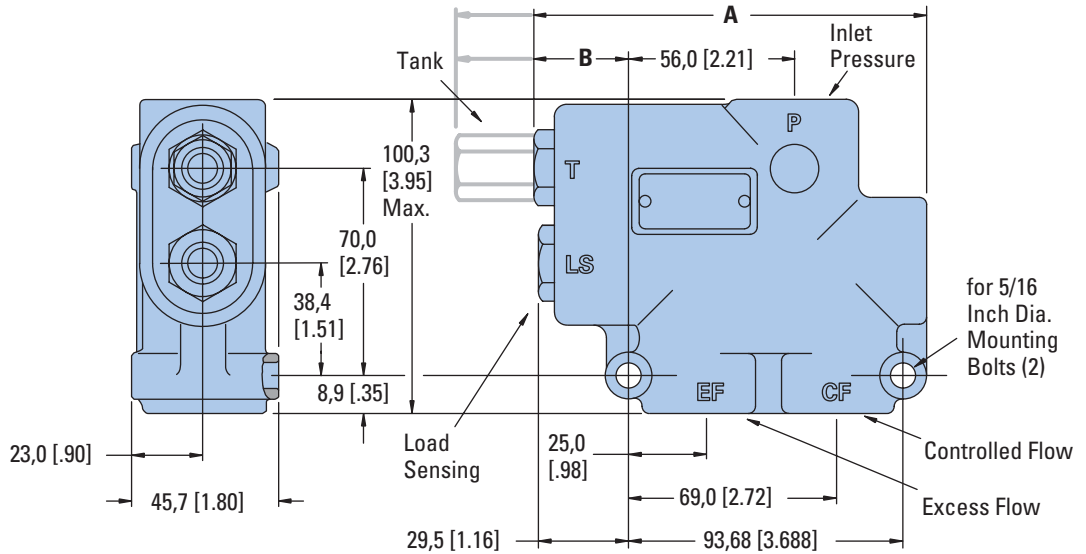
60 l/min [16 GPM] Rate Flow

Dimension	A*	B*
SAE 54,6	136,7 [5.38] Max.	31,2 [1.23]
Metric & R(BSP)	160,5 [6.32] Max.	[2.15]

*Note: Add 9.9 [.39] to A and B dimensions for high pressure models.

Housing Qualified for 276 bar [4000 PSI] Rating Per NFPA.
Relief Valve Qualified for 241 bar [3500 PSI].

High Pressure Relief Valve Qualified for 276 bar [4000 psi] max.



Code Number	System Pressure bar [PSI]
DD	83 [1200]
HE	120 [1725]
LA	138 [2000]
MC	150 [2175]
NC	160 [2300]
QA	172 [2500]
UA	207 [3000]
VD	230 [3325]
VK	240 [3475]

Control Pressure - bar [PSI] / Product Number

Ports (5)	Port Size	Static Signal 3,5 [50]	Dynamic Signal 5,2 [75]	Static Signal 5,2 [75]	Dynamic Signal 7,6 [110]	Static Signal 6,9 [100]	Dynamic Signal 10,0 [145]
P & EF	7/8 - 14	606-1217	606-1232	606-1218	606-1314	606-1219	606-1315
CF	3/4 - 16						
LS & T	7/16 - 20						
P & EF	3/4 - 16	606-1214	606-1327	606-1215	606-1278	606-1216	606-1328
CF	9/16 - 18						
LS & T	7/16 - 20						
P & EF	M22 X 1,5	606-1329	606-1330	606-1331	606-1332	606-1333	606-1334
CF	M18 X 1,5						
LS & T	M12 X 1,5						
P & EF	R 1/2 - 14	606-1335	606-1336	606-1337	606-1338	606-1339	606-1340
CF	R 1/2 - 14						
LS & T	R 1/4 - 19						

Example: 606-1218-00X-QA
 Product Number System Pressure Code Number
 X = Design Level — **NOT** part of Order Number.

The above product number describes a VLC Series with 5,2 bar [75 PSI] control pressure, static signal, 7/8-14 P and EF ports, 3/4-16 CF port, 7/16-20 LS and T ports, 172 bar [2500 PSI] relief valve setting.

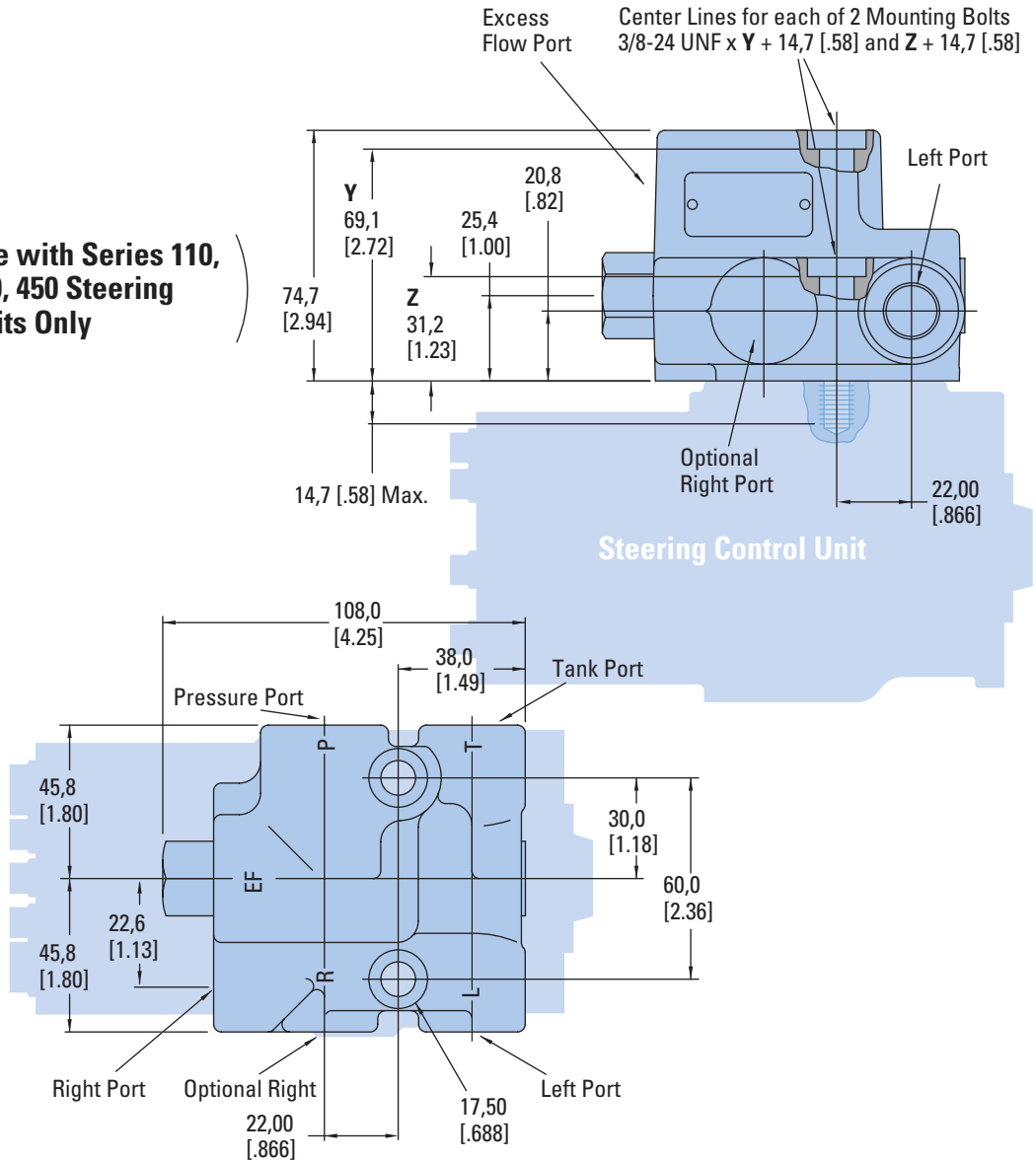
For comprehensive information on all steering system components "Valves" see Eaton catalog 11-508.

Steering System Components

VLC Bolt on Priority Valves (BoPV)

**60 l/min [16 GPM]
Rated Flow
Rated Pressure
276 bar [4000 PSI]**

(Use with Series 110, 230, 450 Steering Units Only)



For comprehensive information on all steering system components "Valves" see Eaton catalog 11-508.

Control Pressure - bar [PSI] / Product Number

Ports (5)	Port Size	Static Signal 3,5 [50]	Dynamic Signal 5,2 [75]	Static Signal 5,2 [75]	Dynamic Signal 7,6 [110]	Static Signal 6,9 [100]	Dynamic Signal 10,0 [145]
P & EF	G 1/2						
CF	G 3/8		612-0003		612-0001		
LS & T	G 3/8						
P & EF	G 1/2						
T, L, & R	G 3/8				612-0005		

Steering System Components

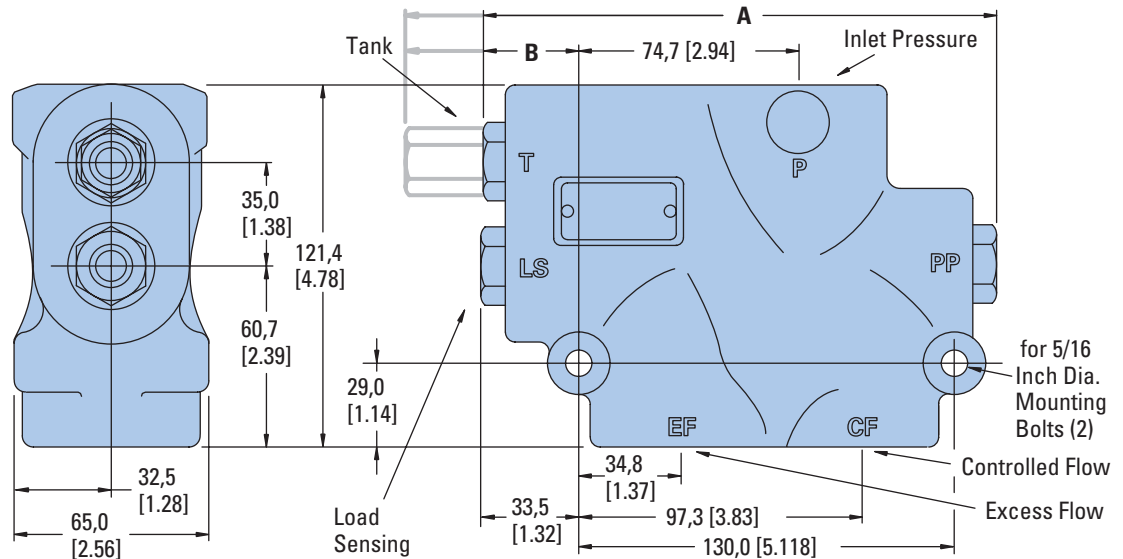
VLE In-Line Priority Valves

150 l/min [40 GPM] Rated Flow

	Dimension	
	A*	B*
SAE	179,3 [7.06] Max.	32,8 [1.29]
Metric & R(BSP)	203,2 [8.00] Max.	56,2 [2.21]

*Note: Add 9,9 [39] to A and B Dimensions for High Pressure Models

Housing Qualified for 276 bar [4000 PSI] Rating Per NFPA. Relief Valve Qualified for 172 bar [2500 PSI] Max.



High Pressure

Relief Valve Qualified for 276 bar [4000 PSI] Max.

Example: 606-1094-00X-QA
 Product Number System Pressure
 Code Number
 X = Design Level — **NOT** part of Order Number.

The product number (above left) describes a VLE Series with 6,9 bar [100 PSI] control pressure, static signal, 1 1/16-12 P and EF ports, 3/4-16 CF port, 7/16-20 LS and T ports, 172 bar [2500 PSI] relief valve setting.

Code Number	System Pressure bar [PSI]
DD	83 [1200]
HE	120 [1725]
LA	138 [2000]
MC	150 [2175]
NC	160 [2300]
QA	172 [2500]
UA	207 [3000]
VD	230 [3325]
VK	240 [3475]

High Pressure*

For comprehensive information on all steering system components "Valves" see Eaton catalog 11-508.

Control Pressure - bar [PSI] / Product Number

Ports (5)	Port Size	Static Signal 4,5 [65]	Dynamic Signal 5,5 [80]	Static Signal 6,9 [100]	Dynamic Signal 8,6 [125]	Static Signal 10,3 [150]	Dynamic Signal 12,8 [185]
P & EF	1 1/16 - 12	606-1093	606-1294	606-1094	606-1295	606-1095	606-1296
CF	3/4 - 16						
LS & T	7/16 - 20						
P & EF	1 1/16 - 12	606-1046	606-1341	606-1047	606-1342	606-1048	606-1343
CF	7/8 - 14						
LS & T	7/16 - 20						
P & EF	1 5/16 - 12	606-1058	606-1344	606-1059	606-1345	606-1060	606-1346
CF	7/8 - 14						
LS & T	7/16 - 20						
P & EF	1 5/16 - 12	606-1141	606-1347	606-1142	606-1348	606-1143	606-1349
CF	1 5/16 - 12						
LS & T	7/16 - 20						
P & EF	1 5/16 - 12	606-1350	606-1282	606-1351	606-1281	606-1352	606-1283
CF	1 1/16 - 12						
LS & T	7/16 - 20						
P & EF	M27 X 2	606-1353	606-1354	606-1355	606-1356	606-1357	606-1358
CF	M18 X 1,5						
LS & T	M12 X 1,5						
P & EF	R 3/4 - 14	606-1359	606-1360	606-1361	606-1362	606-1363	606-1364
CF	R 1/2 - 14						
LS & T	R 1/4 - 19						
High Pressure*							
P & EF	1 5/16 - 12	606-1365	606-1321	606-1366	606-1322	606-1367	606-1323
CF	1 1/16 - 12						
LS & T	7/16 - 20						

Steering System Components

VLH In-Line Priority Valves

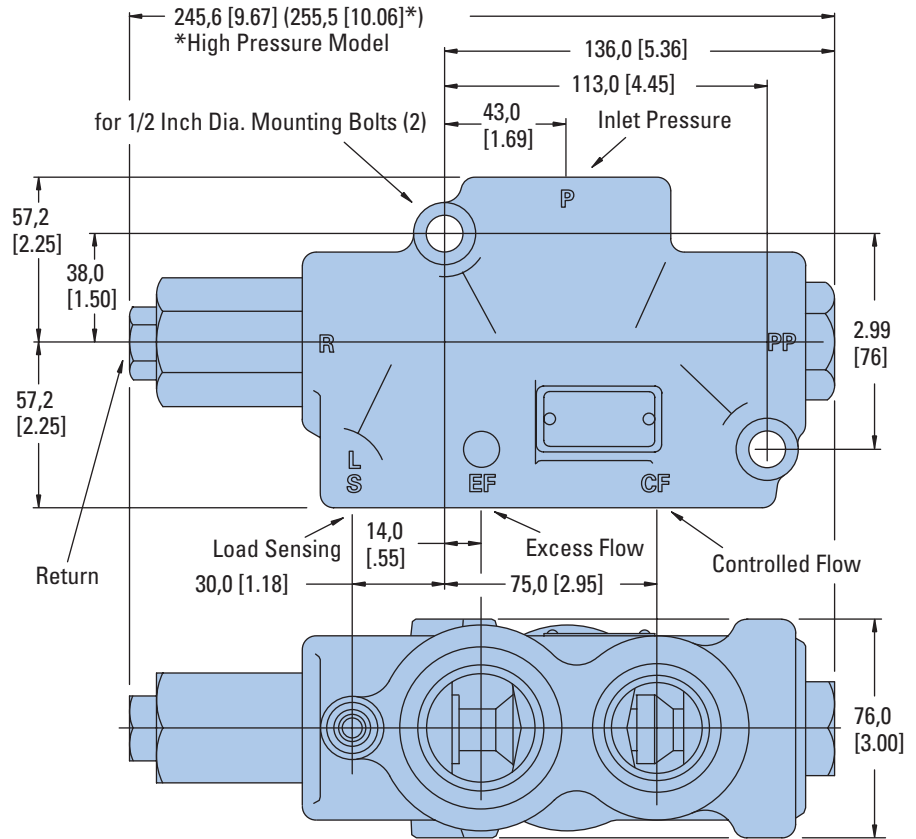
240 l/min [63 GPM] Rated Flow

Code Number	System Pressure bar [PSI]
DD	83 [1200]
HE	120 [1725]
LA	138 [2000]
MC	150 [2175]
NC	160 [2300]
QA	172 [2500]
UA	207 [3000]
VD	230 [3325]
VK	240 [3475]

Housing Qualified for 276 bar [4000 PSI] Rating Per NFPA. Relief Valve Qualified for 172 bar [2500 PSI] Max.

High Pressure

Relief Valve Qualified for 276 bar [4000 PSI].



Example: 606-1202-00X-QA
 Product Number System Pressure Code Number
 X = Design Level — **NOT** part of Order Number.

The product number (above left) describes a VLH Series with 6,9 bar [100 PSI] control pressure, static signal, 1 5/8-12 P and EF ports, 1 5/16-12 CF port, 7/16-20 LS and R ports, 172 bar [2500 PSI] relief valve setting.

For comprehensive information on all steering system components "Valves" see Eaton catalog 11-508.

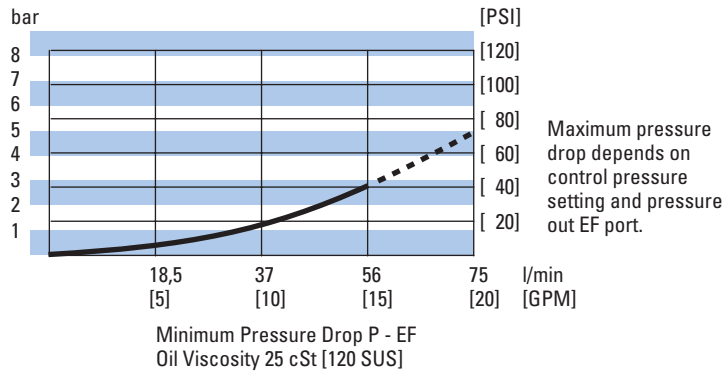
Control Pressure - bar [PSI] / Product Number

Ports (5)	O-ring Port Size	Static Signal		Dynamic Signal		Static Signal		Dynamic Signal	
		5,2 [75]	5,9 [85]	6,9 [100]	7,6 [110]	10,3 [150]	11,4 [165]		
P & EF	1 5/8 - 12								
CF	1 5/16 - 12	606-1201	606-1288	606-1202	606-1289	606-1203	606-1290		
LS & R	7/16 - 20								
P & EF	1 5/8 - 12								
CF	1 1/16 - 12	606-1368	606-1284	606-1369	606-1285	606-1370	606-1286		
LS & R	7/16 - 20								
P & EF	1 5/8 - 12								
CF	3/4 - 16	606-1189	606-1371	606-1190	606-1372	606-1191	606-1373		
LS & R	7/16 - 20								
High Pressure*									
P & EF	1 5/8 - 12								
CF	1 1/16 - 12	606-1374	606-1316	606-1375	606-1317	606-1376	606-1318		
LS & R	7/16 - 20								

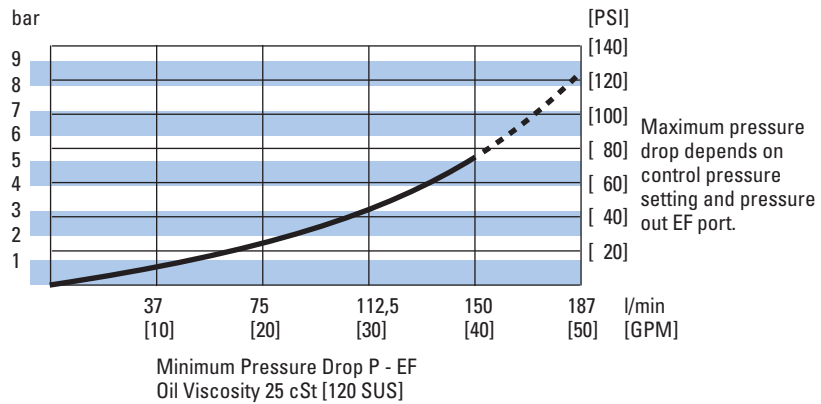
Steering System Components

Pressure Drop Curves for VLC, VLE and VLH Priority Valves

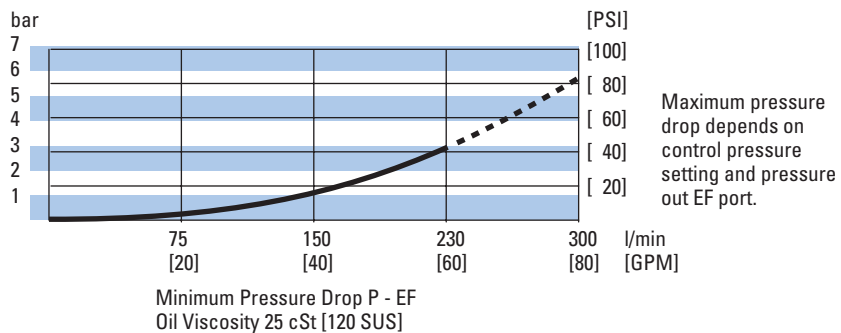
VLC Series



VLE Series

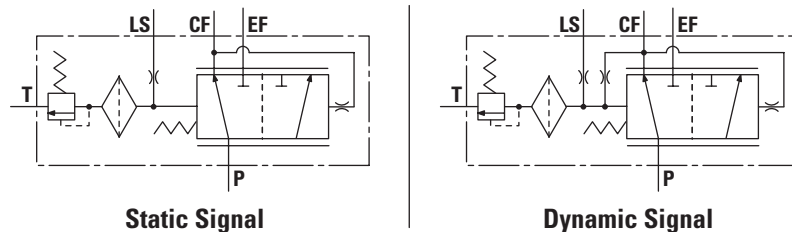


VLH Series



U.S. Patents. Re 26,338; 3,455,210 and 4,043,419 cover circuits using these priority valves. Corresponding foreign patents pending and issued.

Symbols



For comprehensive information on all steering system components "Valves" see Eaton catalog 11-508.

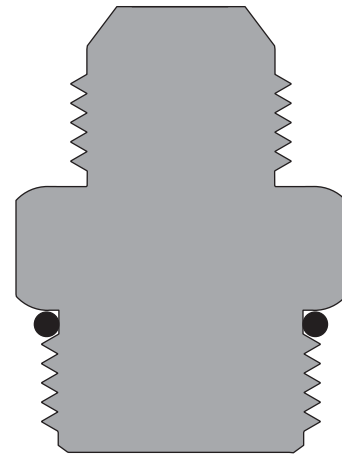
Check Valves

Product Description and Features

These check valves are designed specifically to withstand the rugged duty cycles of a steering system and perform their functions reliably to prevent kickback in the steering wheel.

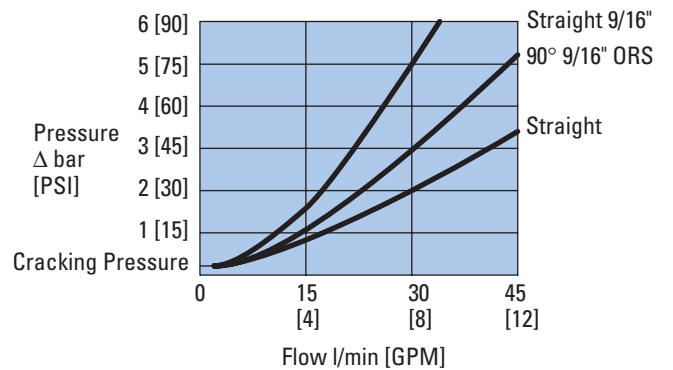
The check valve is installed directly into the pressure port of Char-Lynn® steering control unit. Connection of the hose assembly is either a male 37° end or O-ring face seal (ORS).

Straight 90° elbow configurations are available (see installation drawing next page).



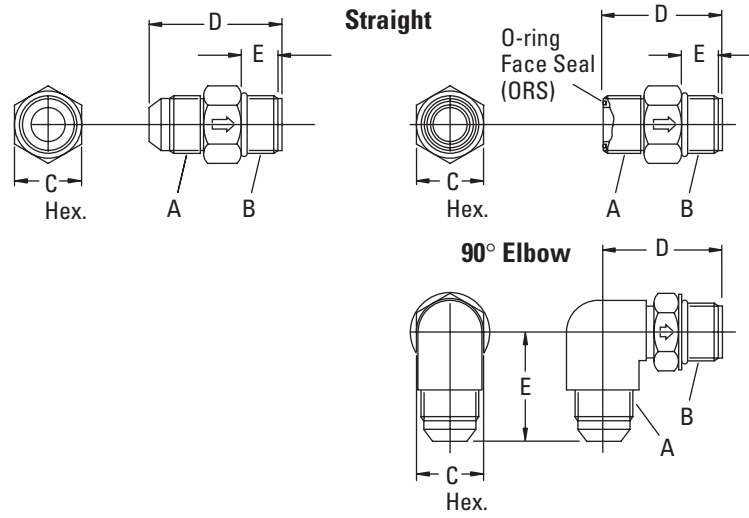
Performance Data

Pressure Drop Curves — Inlet Check Valves



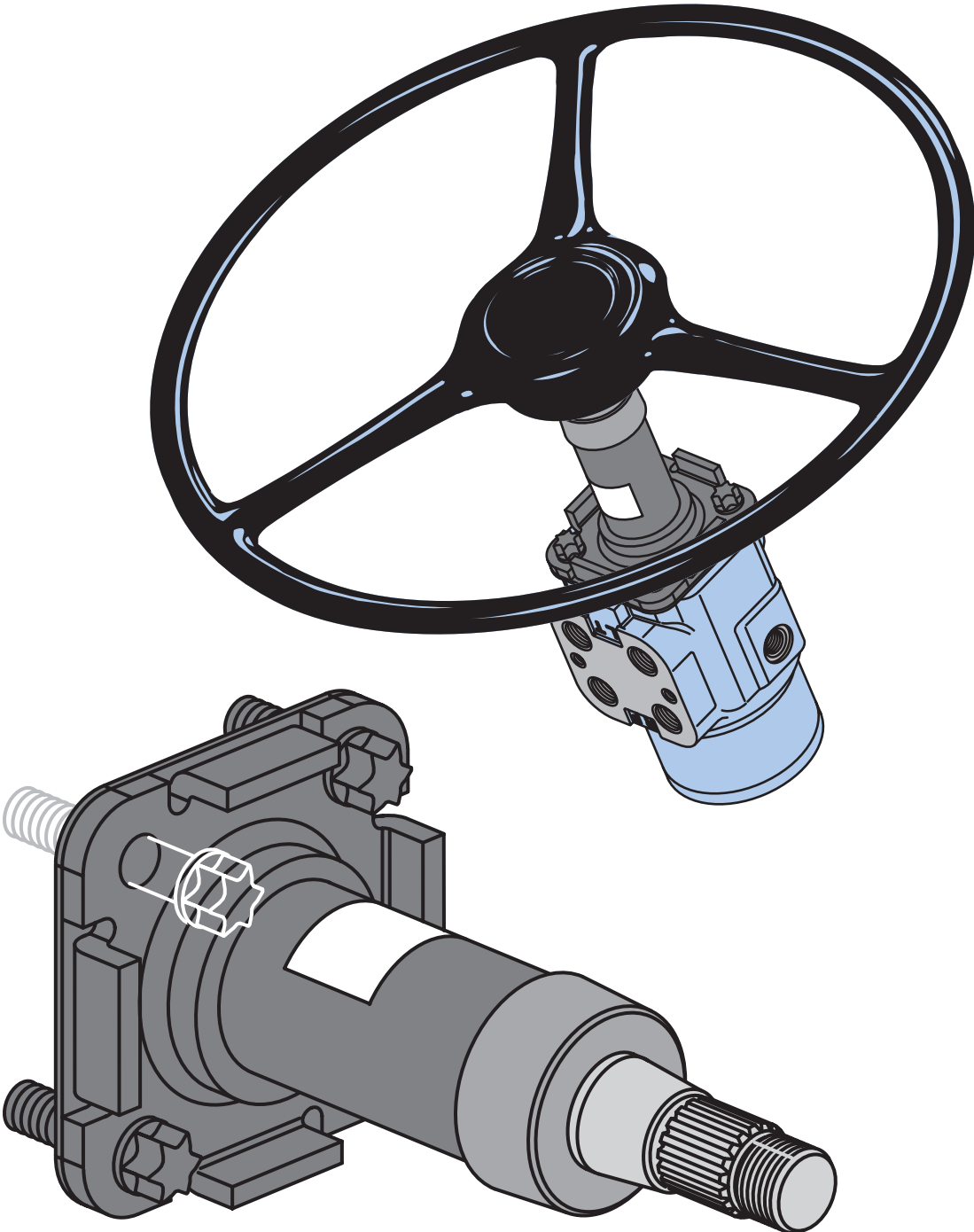
Check Valves

Installation Drawing



Configuration	Product Number	Check Valve Dimensions—mm [in.]					
		A	B	C	D	E	
Straight	37°	608-1003	3/4-16	3/4-16	22,61/22,10 [.89/.87]	43.69/43.18 [1.72/1.70]	14.48/13.46 [.57/.53]
	37°	608-1004	9/16-18	3/4-16	22,61/22,10 [.89/.87]	41.15/40.64 [1.62/1.60]	14.48/13.46 [.57/.53]
	ORS	608-1007	13/16-16	3/4-16	22,61/21,10 [.89/.87]	39.88/39.37 [1.57/1.55]	14.48/13.46 [.57/.53]
	ORS	608-1009	11/16-16	3/4-16	22,61/22,10 [.89/.87]	38.16/37.59 [1.50/1.48]	14.48/13.46 [.57/.53]
90°	ORS	608-1013	11/16-18	3/4-16	24,13/23,62 [.95/.93]	37,6/35,5 [1.48/1.40]	41.15/40.13 [1.62/1.58]

Steering Columns



Steering Columns

Description

Char-Lynn® columns can be custom built to your exact specifications. The column and mounting flange is of a sturdy single weldment design. These columns have high thrust and side load capacity with low shaft torsional friction. Columns are painted with low gloss black finish and the shafts are phosphate coated and oil dipped for corrosion protection.

Features

- Low friction bearings to carry thrust and side loads
- Available dust boot to protect against dirt and moisture
- Four jacket types are available
- Two lower ends and ten upper ends are available
- Two different horn wire configurations
- Length available from 56 to 825 mm [2.2 to 32.5 inch]
- Columns can be pre-assembled to steering units per your request

SPECIFICATIONS

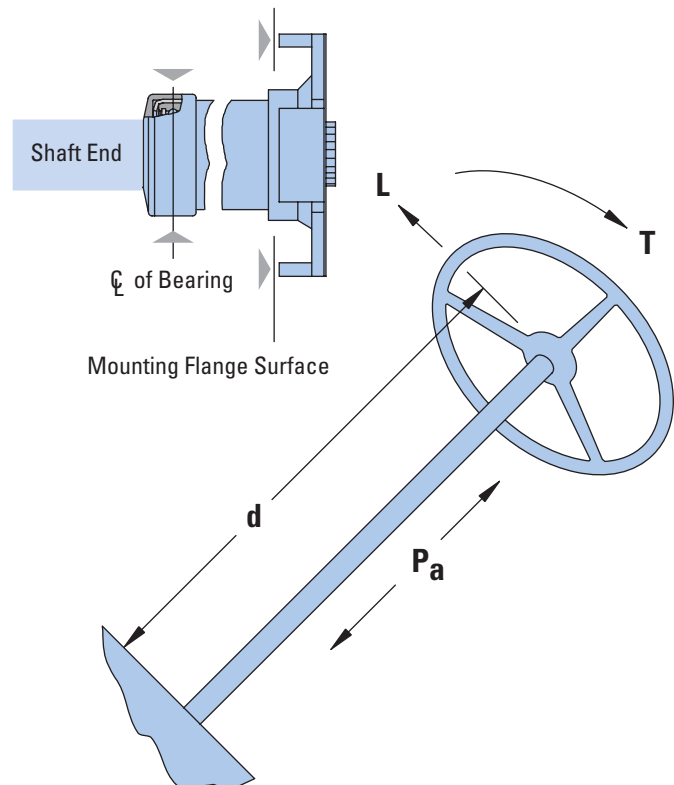
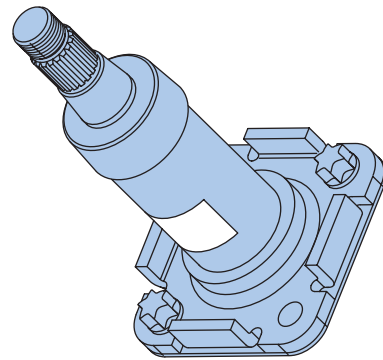
Rated Torsional	81Nm [60 lb-ft]
Rated Bending Moment*	136 Nm [100 lb-ft]
Rated Radial Load**	86 kg [150 lb]
Rated Axial Load	86 kg [150 lb]
Torsional Friction Drag	0,23 kg [2 lb-in]
Recommended Wheel Nut Torque	47 Nm [35 lb-ft]

*Bending moments are taken about the plane of the column mounting surface.

**Radial load at the bearing centerline must not exceed the horizontal bending moment rating.

Five Steps for "How to Order Your Column"

- 1 Select Jacket/Base Type
 - 2 Select Lower Shaft Type
 - 3 Select Upper Shaft End Type
 - 4 Select Length (use suggested standard length)
 - 5 Select Add-On Features
 - a) Horn Wire
 - b) Wire Ends
- Please contact your Eaton Representative if any request differs from our catalog offerings.



Steering Columns

Jacket/Base Type

Example—see model code page 88

Position 4-5

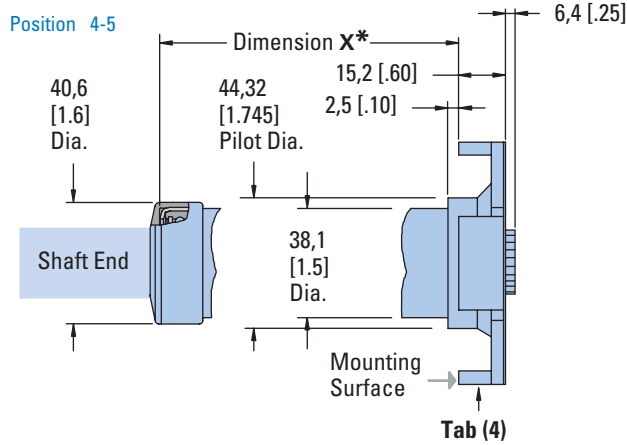
SH Standard with flat flange (No Tabs)

Position 9, 10, 11

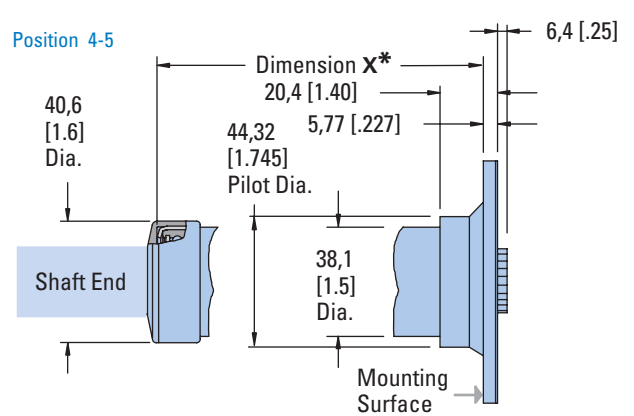
026 66,1 [2.60] (Dimension X)

*Dimension X—see model code page 88 **Position 9, 10, 11 (Jacket Length)**

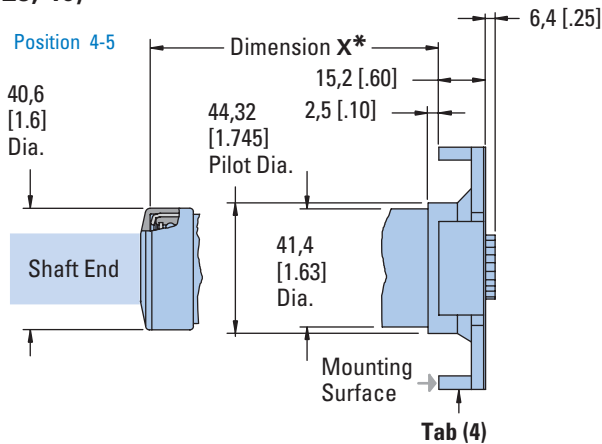
SJ Standard Wall
(Available on Square Series 5, Series 10, 20, 25, 40)



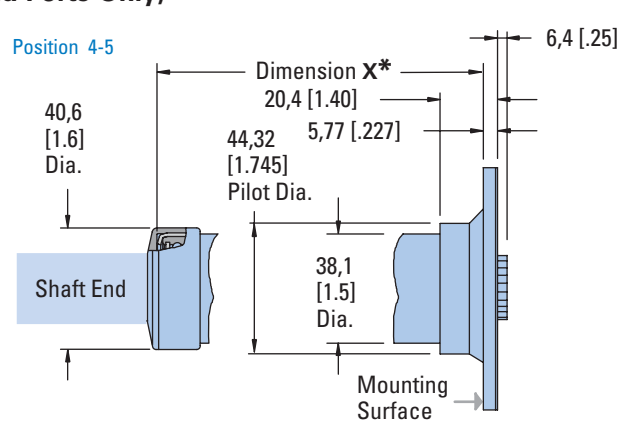
SH Standard Wall
(Available on Square Series 5, Series 10, 20, 25, 40)



HG Heavy Wall (Available on Square Series 5, Series 10, 20, 25, 40)



MN
(Round Series 5 with Side or End Ports Only)



Steering Columns

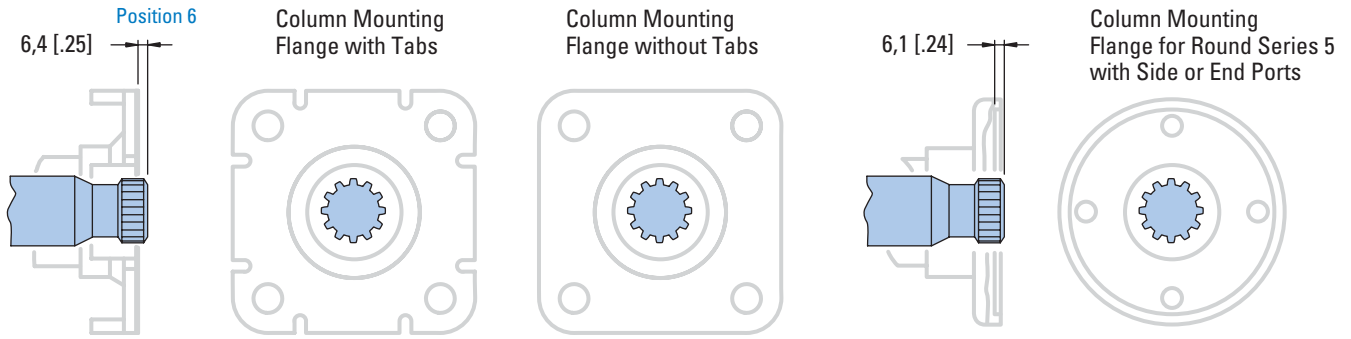
Lower End Type

Example—see model code page 88

Position 6

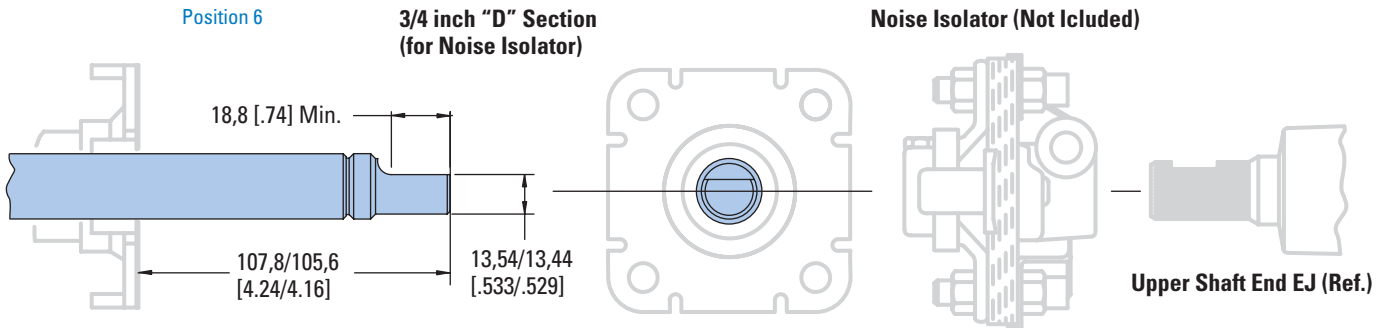
1 12 Tooth Spline for Steering Unit

1



12 Tooth Spline to Fit Char-Lynn® Steering Control Units

3



Steering Columns

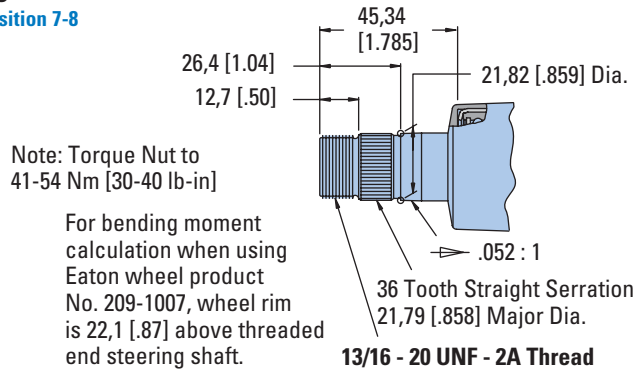
Upper Shaft End

Example—see model code page 88

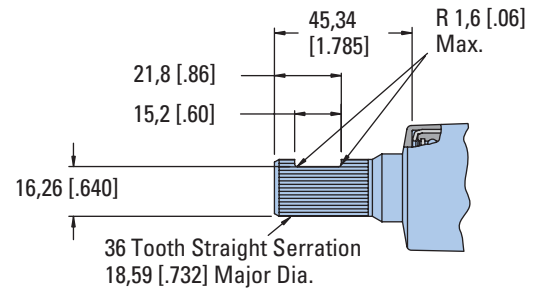
Position 7-8
EJ (36 Tooth Straight Serration)

Not available with horn wire

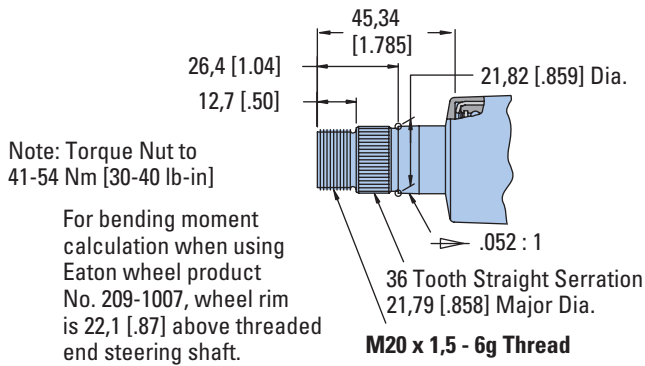
AJ
Position 7-8



EJ
Position 7-8

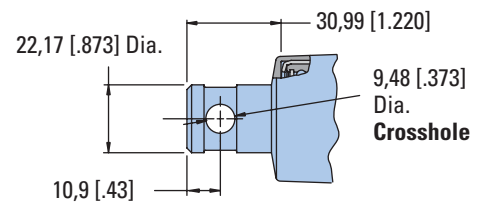


MJ
Position 7-8

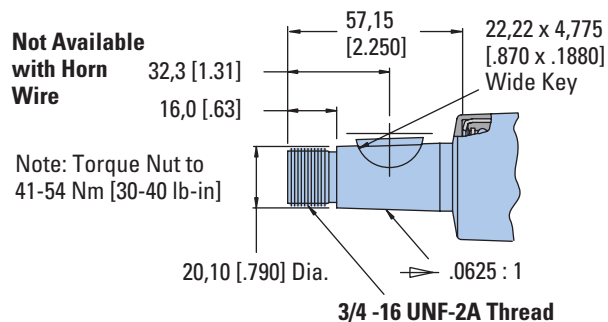


GC
Position 7-8

Not Available with Horn Wire



DN
Position 7-8



Steering Columns

Upper Shaft End (Continued)

Example—see model code page 88

Position 7-8

YM (.050 : 1 Taper M18 x 1,5 - 6g Thread)

Not available with horn wire

CL

Position 7-8

**Not Available
with Horn
Wire**

45,50 [1.790]

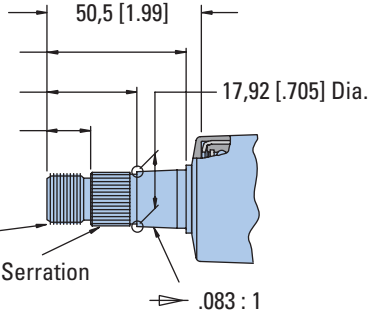
29,36 [1.156]

14,27 [.562]

Note: Torque Nut to
41-54 Nm [30-40 lb-in]

M16 x 1,5 - 6g Thread

40 Tooth Straight Tooth Serration
17,48 [.688] Major Dia.



YM

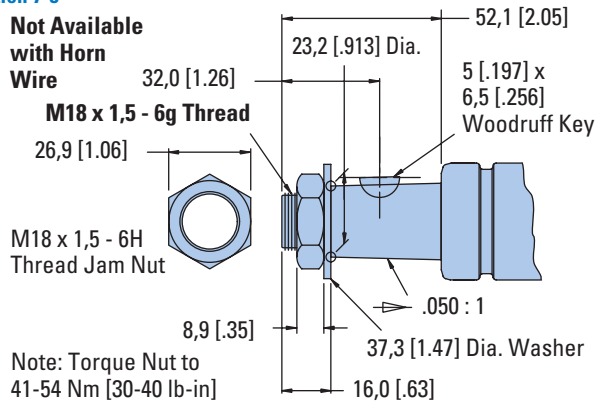
Position 7-8

**Not Available
with Horn
Wire**

M18 x 1,5 - 6g Thread

M18 x 1,5 - 6H
Thread Jam Nut

Note: Torque Nut to
41-54 Nm [30-40 lb-in]



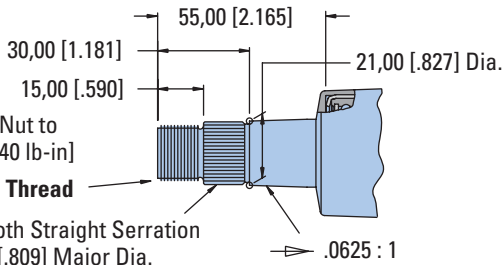
PT

Position 7-8

Note: Torque Nut to
41-54 Nm [30-40 lb-in]

M18 x 1,5 - 6g Thread

36 Tooth Straight Serration
20,55 [.809] Major Dia.



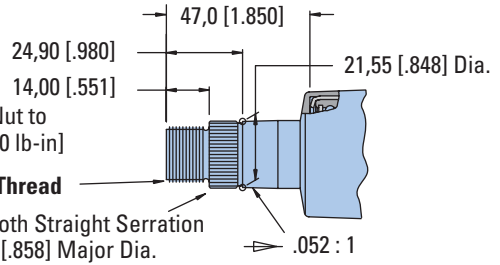
SV

Position 7-8

Note: Torque Nut to
41-54 Nm [30-40 lb-in]

M18 x 1,5 - 6g Thread

36 Tooth Straight Serration
21,79 [.858] Major Dia.



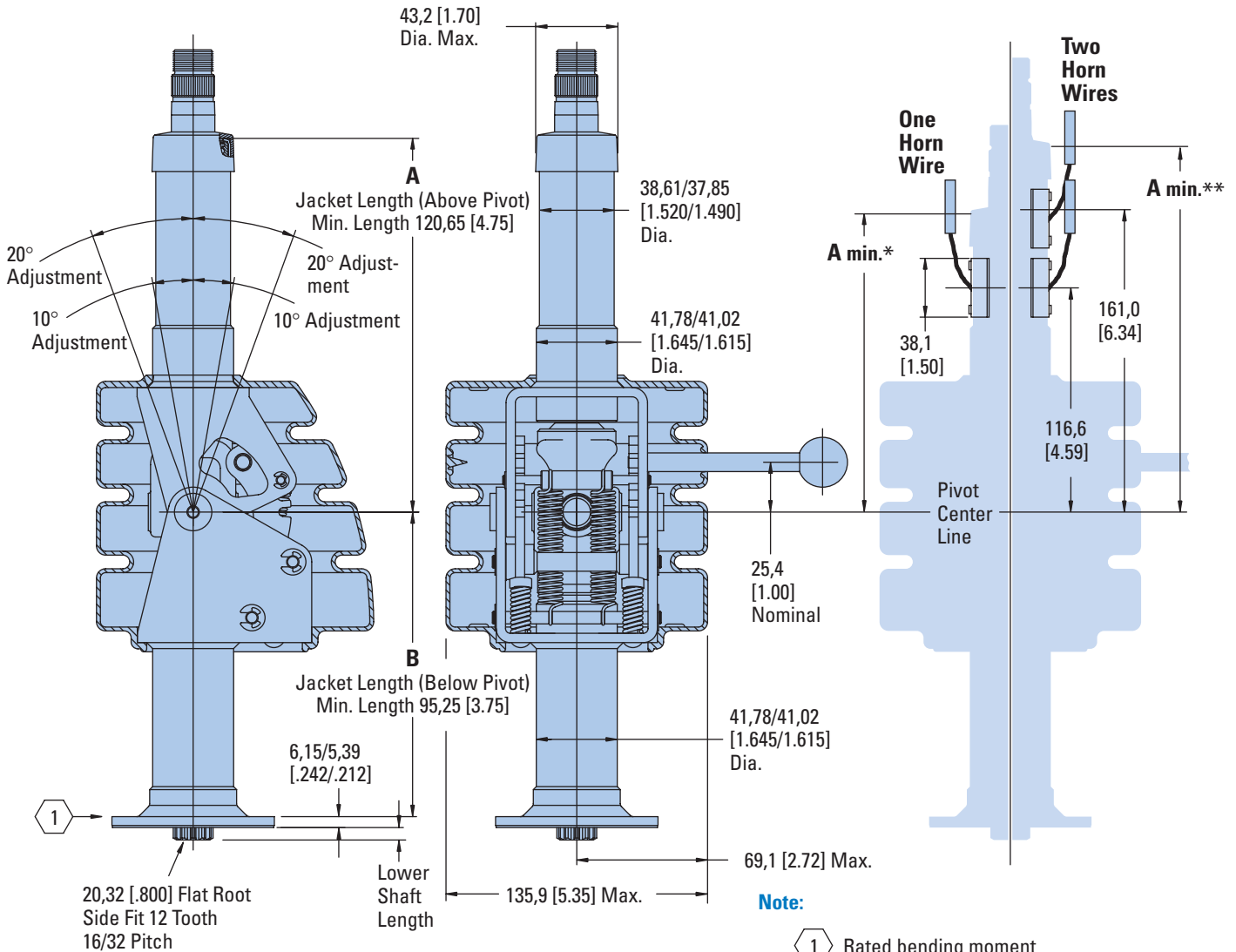
Steering Columns

Tilt Column

Tilt Column—Standard jacket lengths mm [inch]
Dim. A Above Pivot Dim. B Below Pivot

127,0 [5.00]	127,0 [5.00]
190,5 [7.50]	101,6 [4.00]
190,5 [7.50]	546,4 [21.51]

Please contact your Eaton® Representative if any request differs from our catalog offerings. Select add-on features (Position 6 - 21) from the standard column model code (see page 88).



How to Order your Tilt Column:

Model Code — Steering Columns

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
A	C	K	T	A		A	J														A
Position	9	10	11																		
	A	A	C					Dim. A Above Pivot		Dim. B Below Pivot											
	A	A	B					127,0 [5.00]		127,0 [5.00]											
	A	A	A					190,5 [7.50]		101,6 [4.00]											
								190,5 [7.50]		546,4 [21.51]											

*Dim. A (minimum) above pivot is 165,1 [6.5] (with one horn wire)
 **Dim. A (minimum) above pivot is 203,2 [8.0] (with two horn wires)

Note:

- Rated bending moment calculated about point indicated or about centerline of lower column support is 136 Mn [100 lb-ft]. Lever arm for this calculation shall be the distance from point indicated to centerline of radial load.
- Rated steering shaft torque is 81 Nm [60 lb-ft].

Steering Columns— Horn Wire Electrical

Example—see model code page 88

Position 12-16

1A045 Column with one horn wire

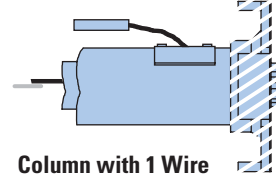
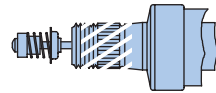
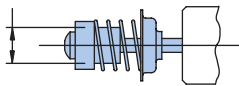
Single Wire

01
Position 18-19

28,4 [1.12]
9,52 [.375] Dia.

Single Wire

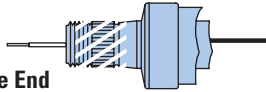
1A045
Position 12-16



Column with 1 Wire

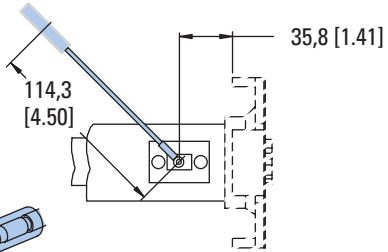
08
Position 18-19

Tinned Bare Wire End



K or D
Position 17

K — Blade Receptacle Insulated — Compatible with 6,4 [.25] Blade Per SAE J858a



D — SAE J928 Type I 3,96 [.156] . Pin Type Male Wire End with Double End Female Connector

Two Wire

02
Position 18-19

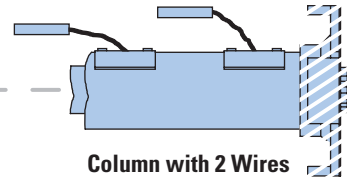
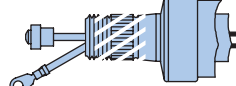
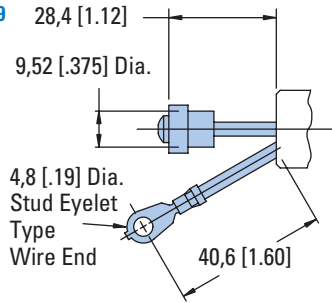
28,4 [1.12]
9,52 [.375] Dia.

Two Wires

One Horn Button with Wire Eyelet (Select with Two Horn Wires)

2B045
Position 12-16

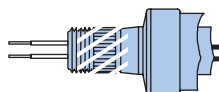
4,8 [.19] Dia. Stud Eyelet Type Wire End
40,6 [1.60]



Column with 2 Wires

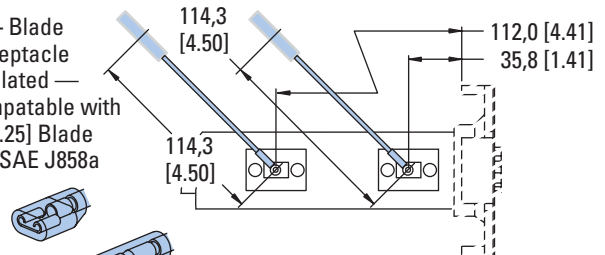
08
Position 18-19

Tinned Bare Wire Ends



K or D
Position 17

K — Blade Receptacle Insulated — Compatible with 6,4 [.25] Blade Per SAE J858a

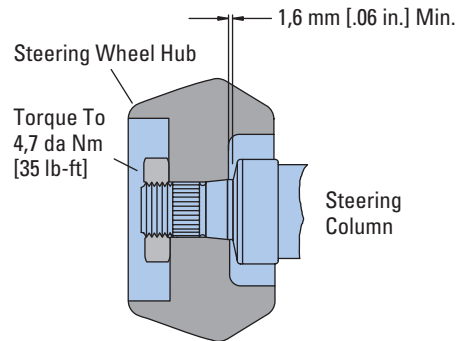


D — SAE J928 Type I 3,96 [.156] Dia. Pin Type Male Wire End with Double End Female Connector

Column and Wheel Mounting

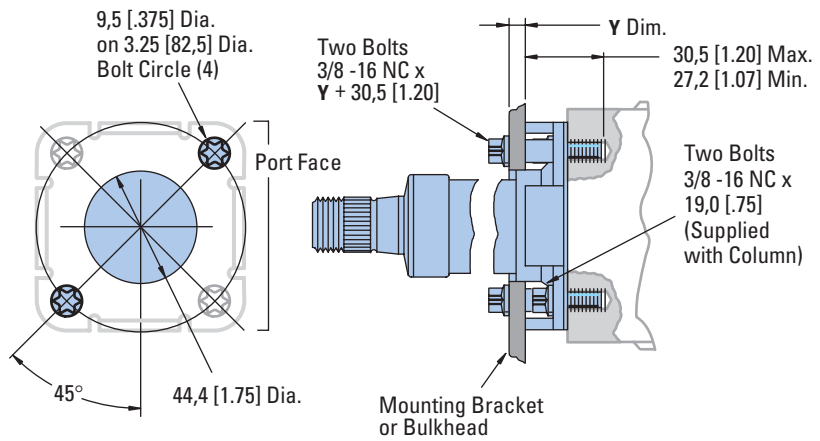
Product Information

Inspect for Minimum Clearance at Assembly



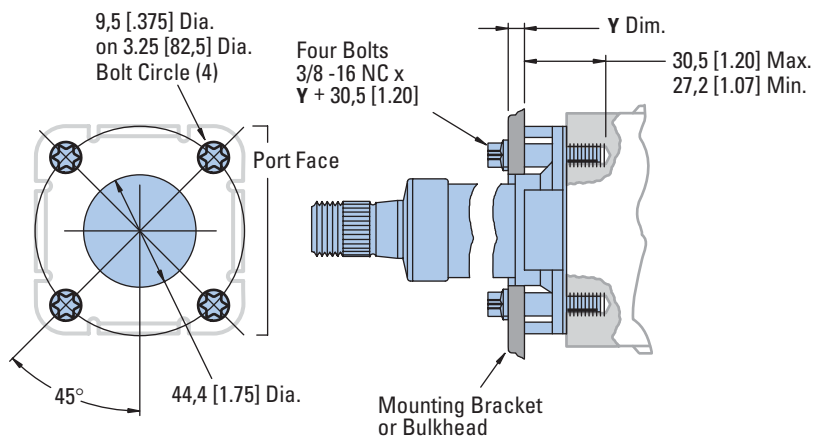
Square Series 5 and Series 10

Must use two bolts through mounting bracket or bulkhead and two bolts through just the steering column or four bolts through mounting bracket or bulkhead.



Series 20, 25

Must use four bolts through mounting bracket or bulkhead.

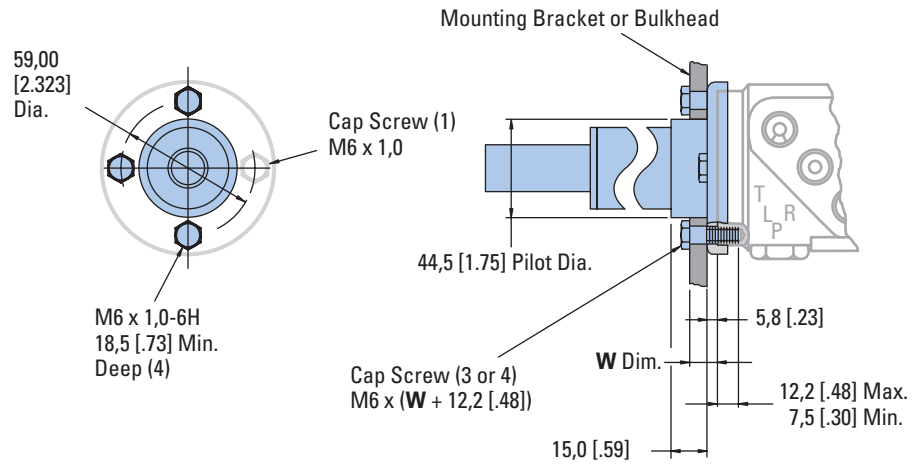


Column Mounting

Product Information

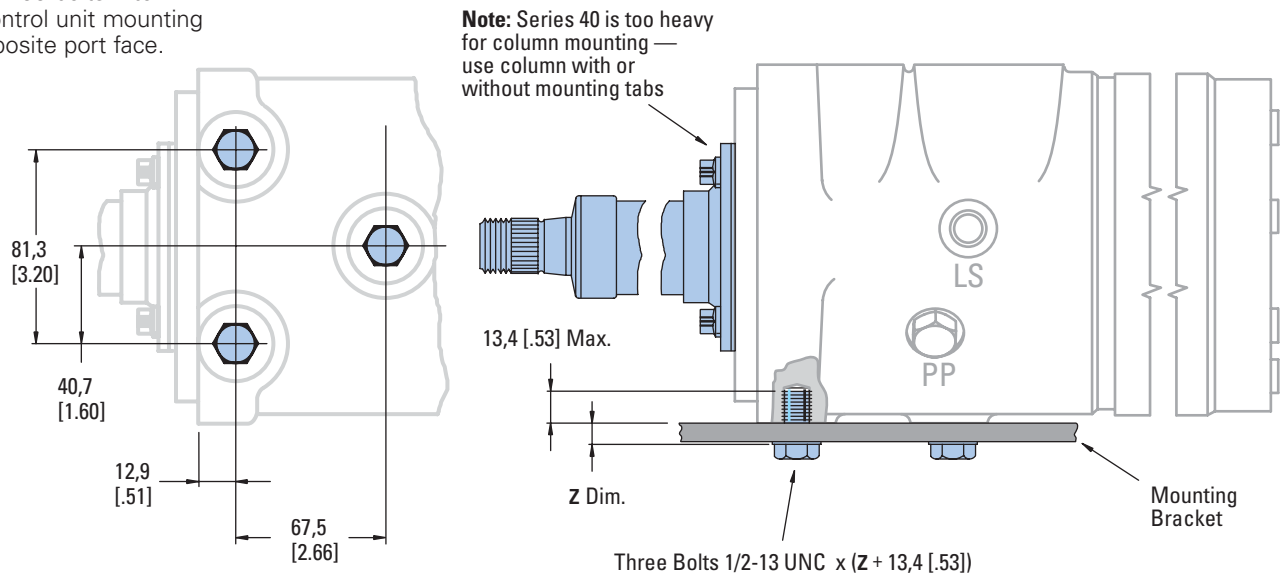
Round Series 5

Must use three bolts minimum.



Series 40

Must use three bolts Into steering control unit mounting bosses opposite port face.



Steering Columns

Model Code Ordering Information

The following 22-digit coding system has been developed to identify all of the configuration options for steering columns. Use this model code to specify a steering column with the desired features. All 22 digits of the code must be present when ordering. You may want to photocopy the matrix below to ensure that each number is entered in the correct box.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
A	C	K																	0	0	

Nos	Feature	Code	Description	Nos	Feature	Code	Description		
1,2,3	Product Series	ACK	Steering Column	120		304,8	[12.00]		
4,5	Jacket/Base Type (page 80)	SJ	Standard (38 mm [1.50 inch] O.D.)	140		355,6	[14.00]		
		MN	Round Series 5 (38mm [1.5 inch] O.D.)	160		406,4	[16.00]		
		HG	Heavy Wall (41,4 [1.63 inch] O.D.)	026		66,1	[2.60]		
			Tabbed Flange	036		92,3	[3.63]		
		SH	Standard With flat Flange (38mm [1.50 inch] O.D.) (No Tabs)	062		157,3	[6.19]		
6	Lower Shaft End (see page 81)	TA	Tilt Column with Flat Flange	081		206,6	[8.13]		
		1	12 Tooth Spline for Steering Unit	103		260,2	[10.24]		
		3	3/4 inch "D" Section (for Noise Isolator)	111		282,8	[11.13]		
				121		308,2	[12.13]		
				162		409,3	[16.11]		
				182		461,1	[18.15]		
				257		651,6	[25.65]		
				276		701,9	[27.63]		
				302		765,9	[30.15]		
				329		835,7	[32.90]		
7,8	Upper Shaft End (see illustrations and specifications page 82, 83)	AJ	Standard for all rigid and tilt columns Available with or without Horn Wire	AAA		190,5	[7.50] Above Pivot		
		MJ	Available with or without Horn Wire			546,4	[21.51] Below Pivot		
		DN	Not Available with Horn Wire	AAB		190,5	[7.50] Above Pivot		
		EJ	Not Available with Horn Wire			101,6	[4.00] Below Pivot		
		GC	Not Available with Horn Wire	AAC		127,0	[5.00] Above Pivot		
		CL	Not Available with Horn Wire			127,0	[5.00] Below Pivot		
		PT	Available with or without Horn Wire						
		SV	Available with or without Horn Wire						
YM	Not Available with Horn Wire								
9,10,11	Jacket Length mm [in.] (Suggested Std. Dim.) (page 80)	022	56,6 [2.23]	12-16	Horn Wire Feature (page 85)	00000	No Horn Wire		
		033	82,8 [3.26]			1A045	Single Horn Wire		
		058	147,8 [5.82]			2B045	Two Horn Wires		
		078	197,1 [7.76]			0	None—Select When No Horn Wire Used		
		099	250,7 [9.87]			D	SAE J928 Pin and Double End Connector		
		108	273,3 [10.76]			K	Blade Receptacle—Insulated (Compatible with SAE J858a)		
		118	298,7 [11.76]			18,19	Shaft End Wire		
		157	399,8 [15.74]				Terminal		
		178	451,6 [17.78]				00	None	
		253	642,1 [25.28]				01	One Horn Button (Only with One Horn Wire)	
		273	692,4 [27.26]				02	One Horn Button with Wire Eyelet (Select with Two horn Wire)	
		298	756,4 [29.78]				08	Tinned Bare Wire End	
		325	826,3 [32.53]			20,21	Special Feature	00	None
		060	152,4 [6.00]			22	Eaton Assigned Design Code		
		080	203,2 [8.00]						
100	254,0 [10.00]								

BOLT & NUT KITS

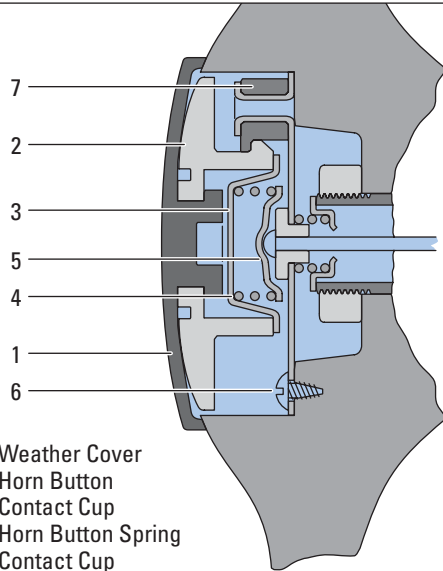
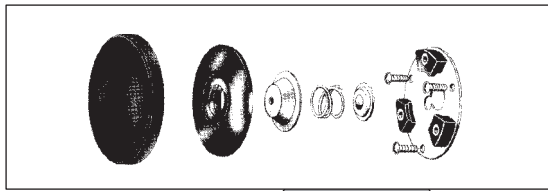
Separate kits are available for purchase to use with steering columns

Metric Cap Screw Kit	M10 x 1.5 Thread x 20mm Lenth (Qty 4)	9900157-000
Standard Cap Screw Kit	.375-16 UNC Thread x .75" Length (Qty 4)	9900158-000
Metric Jam Nut Kit	M18 x 1.5 (Qty 1)	9900159-000
Hex Nut Kit	13/16-20 NEF (Qty 1)	9900160-000
Hex Nut Kit	1 1/2 - 12 UNF (Qty 1)	9900161-000

Steering Columns

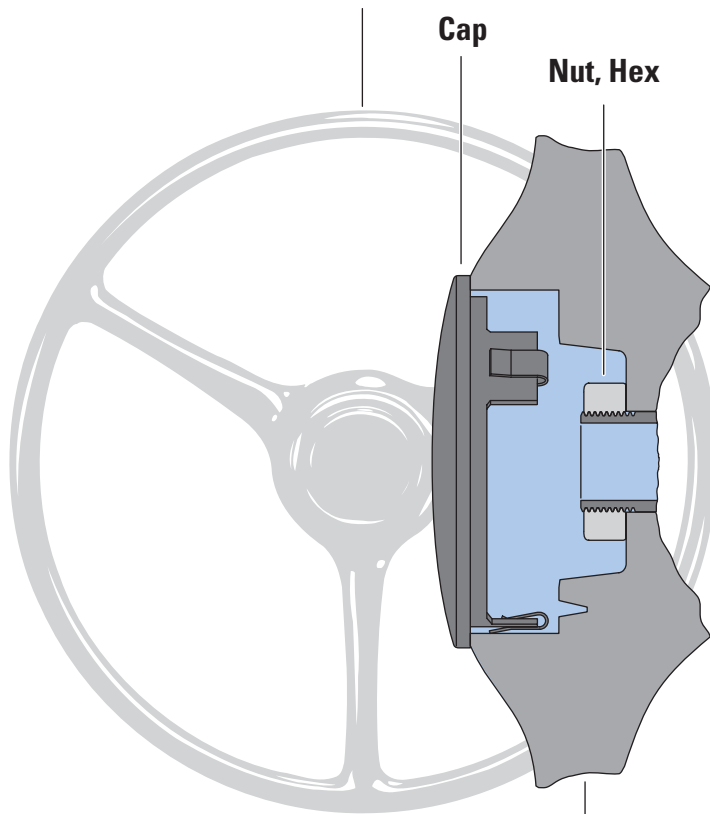
Auxiliary Column Equipment

Horn Button Kit



- 1 Weather Cover
- 2 Horn Button
- 3 Contact Cup
- 4 Horn Button Spring
- 5 Contact Cup
- 6 Screw
- 7 Base Plate Assembly

Steering Wheel



Steering Wheel Hub Section

Steering Wheel No. 209-1007

Molded black wheel with three equally spaced spokes, (relatively flat, without recessed hub) diameter 430 mm [17 inch] for column with upper shaft end AJ or MJ.

Note: Steering wheel hub has tapped holes for wheel puller.

Horn Button Kit No. 208-1013

For Char-Lynn® steering column with serrated upper shaft end AJ or MJ and Char-Lynn® 430 mm [17 inch] steering wheel.

Cap No. 209-1005

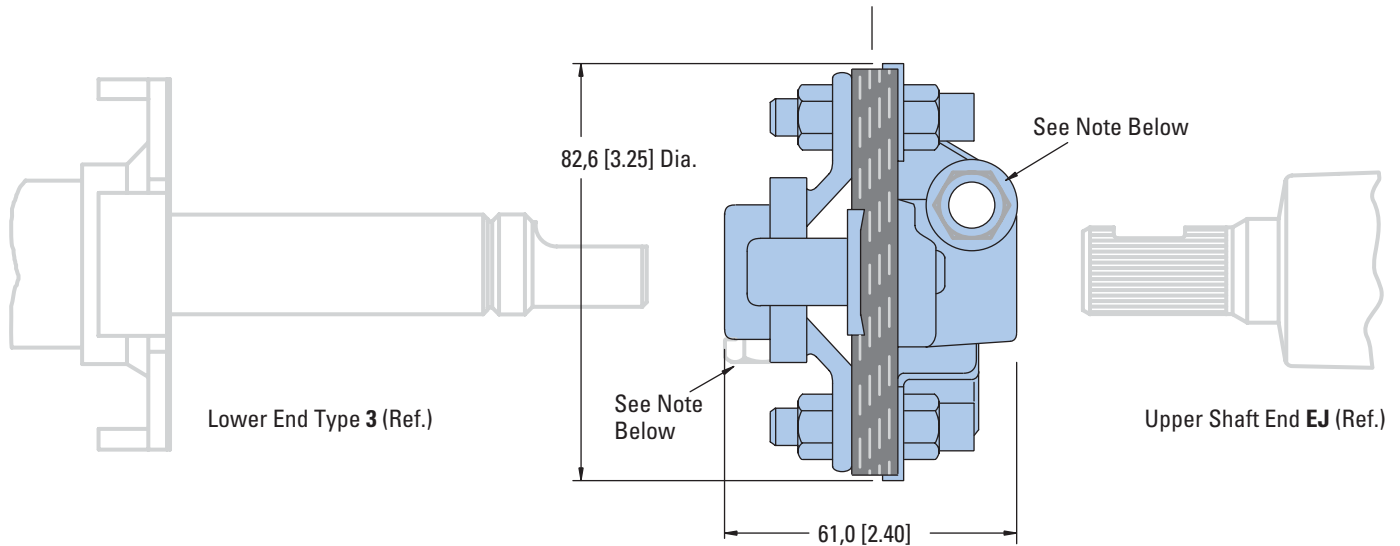
Char-Lynn® steering wheel hub cavity cap, for no horn installations.

Nut, Hex Part Number	Upper Shaft End Configuration (See Page xx, xx)	Thread Size
14517	PT, SV	M18 x 1,5
14593	MJ	M20 x 1,5
14603	CK, CL	M16 x 1,5
21084	AJ	13/16-20 UNF

Steering Columns

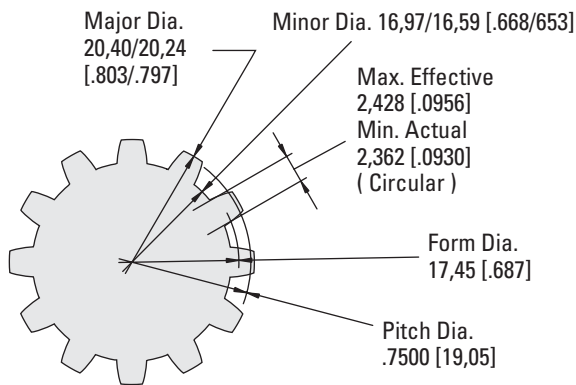
Auxiliary Column Equipment

**This Noise Isolator is Available from
Eaton—Part Number 208-1017-002**



Note: Two screws (3/8-24 UNF x 31,8 [1.25] long — **not included**) are required to join isolator to mating steering columns. Torque screws to 41 Nm [360 lb-in].

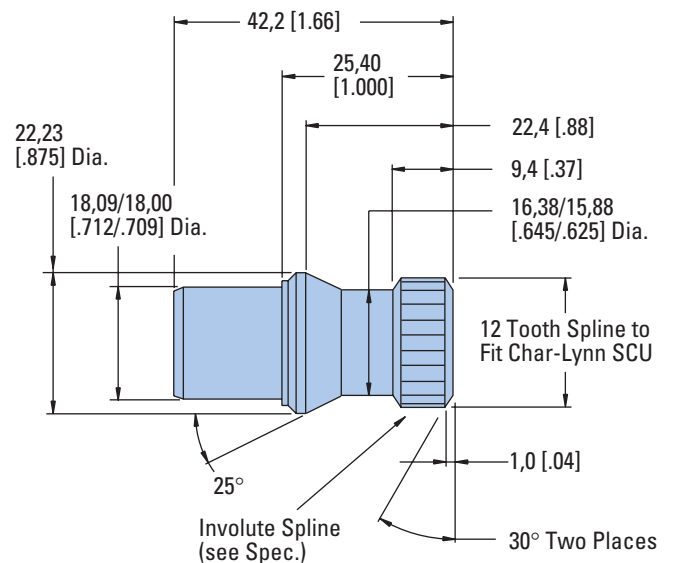
**Want to Make your Own Column? You Must
use these Spline Specs. Lower Shaft End**



Fit	Flat Root Side Fit
Number of Teeth	12
Pitch	16/32
Pressure Angle	30°
Class of Fit	Special
Circular Tooth Thickness	
Max. Effective	2,428 [.0956]
Min, Actual	2,362 [.0930]

Splined End—AISI 8620 Mt'l Case hardened to RC 40-50

**This Splined Lower Shaft End Part (as shown below) is
Available from Eaton—Part Number 8063**



12 Tooth Spline Specification (left)

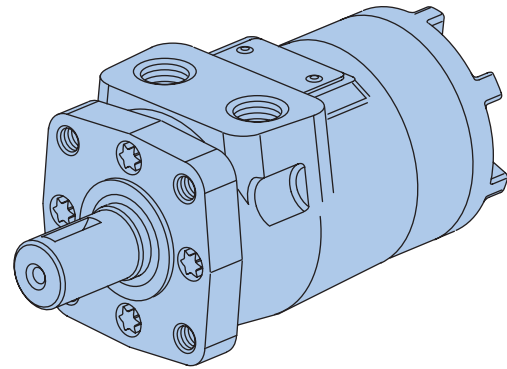
Can be press fit and welded into a 22,22 [.875] OD x 2,16 [.085] wall steel tube.

Steering System— T Series Hydraulic Motors

Product Description

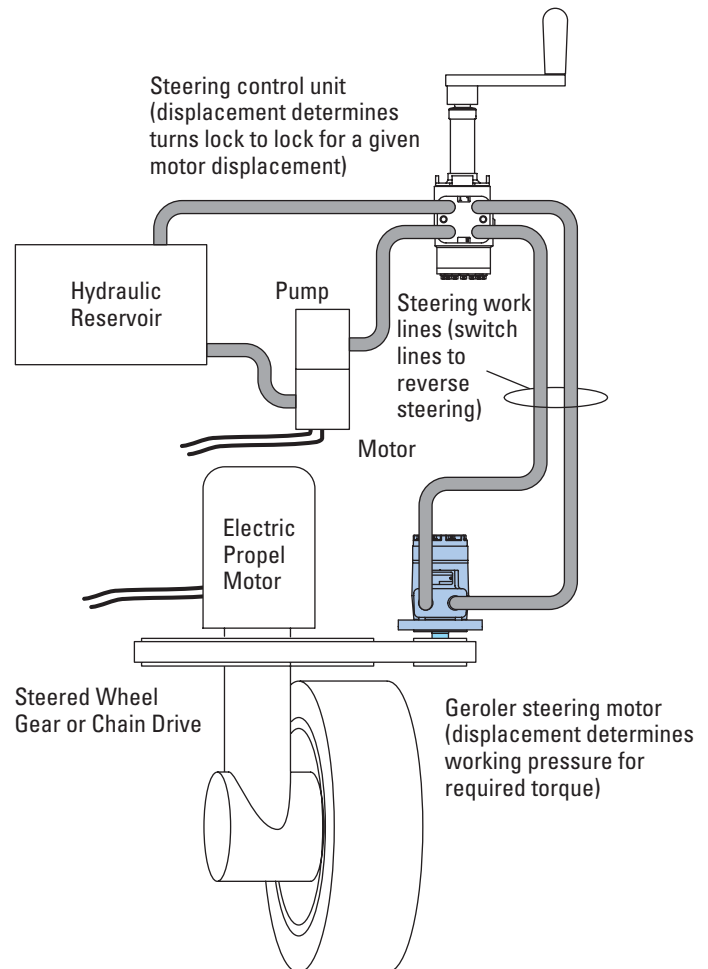
Char-Lynn® T Series low speed, high torque Geroler® motor developed with low speed/low leakage valving specifically for steering applications (see Catalog 11-885 General Purpose Motors H, S, and T Series page 39 Code AB, Position 11-12).

Pressure Capability	
Continuous	155 bar [2250 PSI]
Intermittent	190 bar [2750 PSI]
Speeds	
	up to 1055 RPM
Torque	
Continuous	440 Nm [3905 lb-in]
Intermittent	510 Nm [4515 lb-in]
11 Displacements to	
	36 cm ³ /r [2.2 in ³ /r] 370 cm ³ /r [22.6 in ³ /r]



Comprehensive T Series Motor Description

(See Char-Lynn General Purpose Motors H, S, T Series Cat. 11-885)



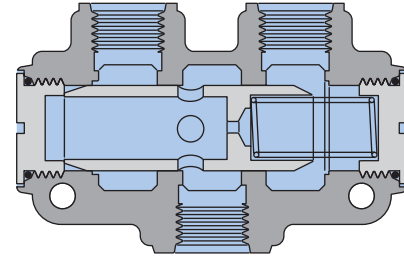
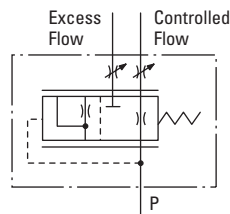
Steering System Components

Flow Divider Valves

Model 32306 Priority Flow Divider

Specifications

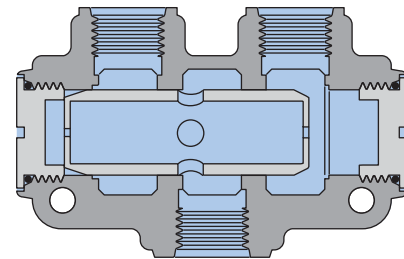
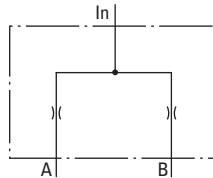
Rated Input Flow	96,6 l/min [25 GPM]
Rated Pressure	172,4 bar [2500 PSI]
Max. Pressure Drop Through Valve at Rated Input Flow	4,5 bar [65 PSI]



Model 32501 Proportional Flow Divider

Specifications

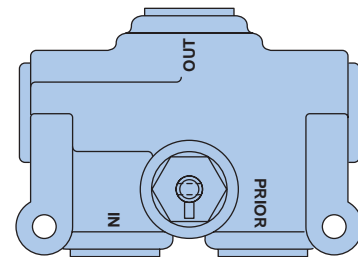
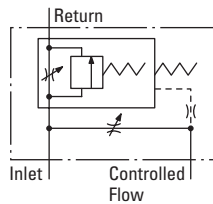
Rated Input Flow	113,6 l/min [30 GPM]
Rated Pressure	172,4 bar [2500 PSI]
Max. Pressure Drop Through Valve at Rated Input Flow	8,6 bar [125 PSI]



Model 32700 Variable Priority Flow Control

Specifications

Rated Input Flow	75,7 l/min [20 GPM]
Rated Pressure	172,4 bar [2500 PSI]
Max. Pressure Drop Through Valve at 56,8 l/min [15 GPM] Input	4,0 bar [48 PSI]
Max. Controlled Flow	36,0 l/min [9.5 GPM]
Controlled Flow Adjustment Range	5,7 - 36,0 l/min [1.5 - 9.5 GPM]
Relief Valve Factory Setting	151,7 bar [2200 PSI] at 36,0 l/min [9.5 GPM]



Comprehensive Flow Divider Description

(see Eaton Flow Divider Catalog 11-508)

Steering System Components Brake Valve

Product Description

Eaton® Hydraulics' new load-sensing brake valve makes power brakes an economical and efficient feature on lift trucks.

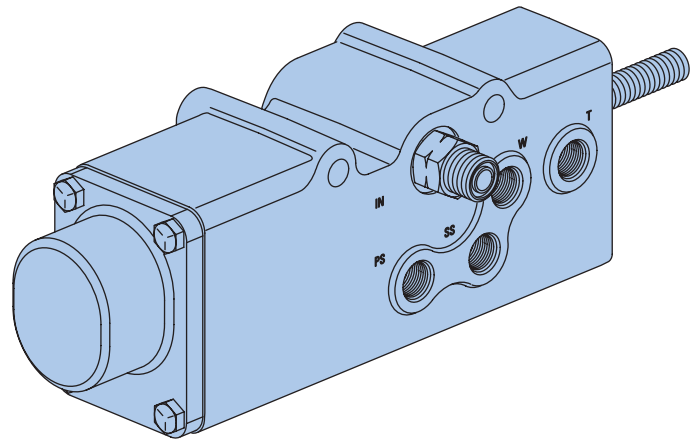
While power brakes in lift trucks can aid productivity, incorporating them into lift trucks has traditionally been expensive. The need for additional flow meant extra plumbing, plus the addition of a dedicated pump or a high pressure accumulator for the brake circuit. The increased system size also meant extra demand on the engine, resulting in reduced fuel economy.

The Eaton brake valve provides a better solution. Used in conjunction with load-sense steering and a priority valve, it can work with an existing system. A dedicated flow source is not required. It also ensures that brakes and steering have priority over the hoist circuit.

Eaton's new brake valve has a shuttle in the sensing port which allows the priority valve to determine whether brakes or steering require higher pressure. The priority valve then shifts to provide adequate flow and pressure for the function with the greatest needs. An integral pressure-compensated flow limiter provides low flow for brake modulation. This feature of the brake valve allows simultaneous braking and steering without steering interruption or pedal kick.

The design of the circuit also increases efficiency. The control flow line of the circuit is connected in parallel to both the brake valve and the steering unit. Thus, brake and steering pressures are not additive during simultaneous operation. The existing steering pressure is usually enough to provide full power braking.

Another feature of the Eaton brake valve is that it accommodates dead engine braking. The valve contains a large internally cored area that acts as a reservoir, providing oil for brake actuation in the manual mode. The valve design allows the volume and pressure required for manual braking to be generated without excessive pedal force. Thus, the load-sensing brake valve offers the benefits of powered brakes and manual brakes in a single package, eliminating the need for an accumulator.



Features

- No dedicated pressure source (separate pump or accumulator) required when the Eaton Power Brake Valve is used
- Reduces plumbing requirements
- Efficient—no parasitic loss
- Self-contained compact package
- Two-stage master cylinder with built-in reservoir provides dead-engine braking
- Lower input efforts and reduced pedal travel for braking
- Optional pilot operated check valve

Specifications—Valve

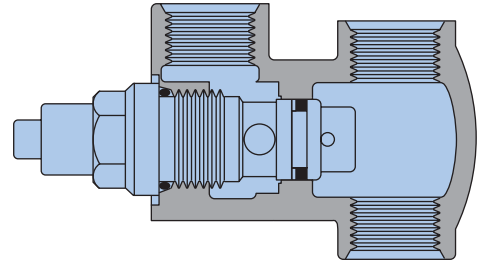
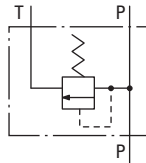
Max. Rated Pressure	205 bar [3000 PSI]
Rated Flow	11 l/min [3.0 GPM]

Steering System Components— Relief Valves

Model 32107 In-Line Relief Valve—Direct Acting Cartridge

Specifications

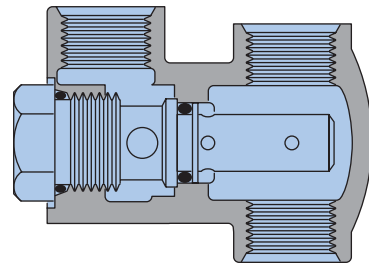
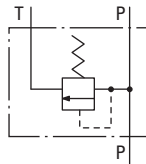
Max. Flow Through Relief Valve	57 l/min [15 GPM]
Relief Valve Setting Range	47–276 bar [675–4000 PSI]
Standard Relief Valve Setting	138 bar [2000 PSI]
Housing Rated Pressure	345 bar [5000 PSI]



Model 32107 In-Line Relief Valve—Pilot Operated Cartridge

Specifications

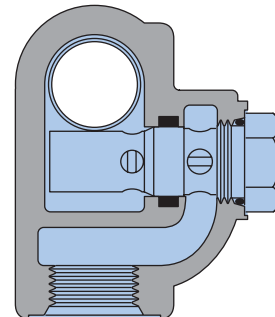
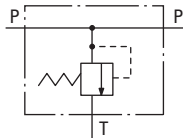
Max. Flow Through Relief Valve	75,7 l/min [20 GPM]
Relief Valve Setting Range	103–241 bar [1500–3500 PSI]
Housing Rated Pressure	345 bar [5000 PSI]



Model 32112 In-Line Relief Valve

Specifications

Max. Flow Through Relief Valve	132,5 l/min [35 GPM]
Relief Valve Setting Range	69–241 bar [1000–3500 PSI]
Housing Rated Pressure	345 bar [5000 PSI]



Comprehensive Relief Valve Description

(see Eaton Relief Valve
Catalog 11-510)

Steering System Components— Gear Pump Series 26

Product Description

Eaton®'s Hydraulics Division has produced gear pumps and motors for many years and has continually improved and upgraded this product line to keep up with the demands of the marketplace. The Series 26 high pressure gear pump is the newest addition to this popular product line.

In developing this new series of gear pumps, Eaton engineers made several significant design changes that have resulted in improved efficiency and quiet operation. The method of lubricating the inlet bearing helps to improve volumetric efficiency for more power output. More power also goes into the pump because of the super polished shaft and gears. This feature also adds to the service life and reliability of the pump. The 13 tooth gears minimize flow ripple that, in turn, reduces noise and vibration.

Features

Quiet Operation

- The 13-tooth gears, versus 10 teeth in previous pumps, minimizes the flow ripple. This reduces noise as well as vibration.
- The improved trap reliefs not only increase power, they also help keep oil flowing smoothly to reduce noise.

Improved Efficiency

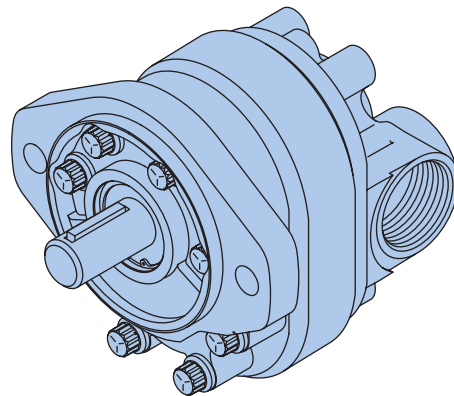
- Improved bearing lubrication system uses inlet oil instead of high pressure oil, improving volumetric efficiency for more power output.
- The super polished shaft and gears improve mechanical efficiency and reduce wear on these components, adding to the service life and reliability of the pump.
- The optimized trapped oil relief areas help reduce pressure ripple for quieter operation. This also decreases the input power requirements.

Field Reversible

- The innovative new wear plate permits simple field reversibility of the pump direction. Simply open the pump, switch the drive gear and idler gear, reposition the plug and reassemble. No extra parts are needed.

Interchangeability

- The Series 26 gear pump has been designed to retrofit equipment using the B1 and B2 gear pumps. Extra shafts, porting, and mounting configurations, as well as 13 available displacements, give you the choices you need for an easy conversion to this superior pump.



GENERAL SPECIFICATIONS

Displacements (13) from	6,6 cm ³ /r [.40 in ³ /r]
to	30,6 cm ³ /r [1.87 in ³ /r]
Mounting Flange	SAE 2 Bolt A
Max. Continuous Pressure	207 bar [3000 PSI]
Max. Intermittent Pressure	241 bar [3500 PSI]
Min. Speeds at Continuous Pressure	750 RPM
Max. Rotating Torque at 0 Pressure	4 Nm [36 lb-in]
Max. Continuous Inlet Temperature	107°C [225°F]
Min. Operating Temperature	-29°C [-20°F]
Max. Inlet Vacuum at Operating Conditions	6.0 in. Hg

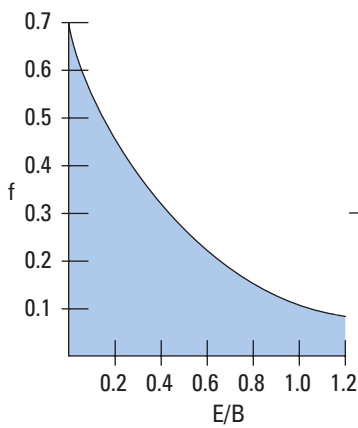
Comprehensive Series 26 Pump Description

(see Eaton Gear Pumps Series 26 Model 26000 Catalog 11-609)

Sizing and Application—

Ackerman Type Steering

Step One: Kingpin Torque



Typical values based on rubber tired vehicles on dry concrete.

$$T = w \cdot f \sqrt{\frac{B^2}{8} + E^2}$$

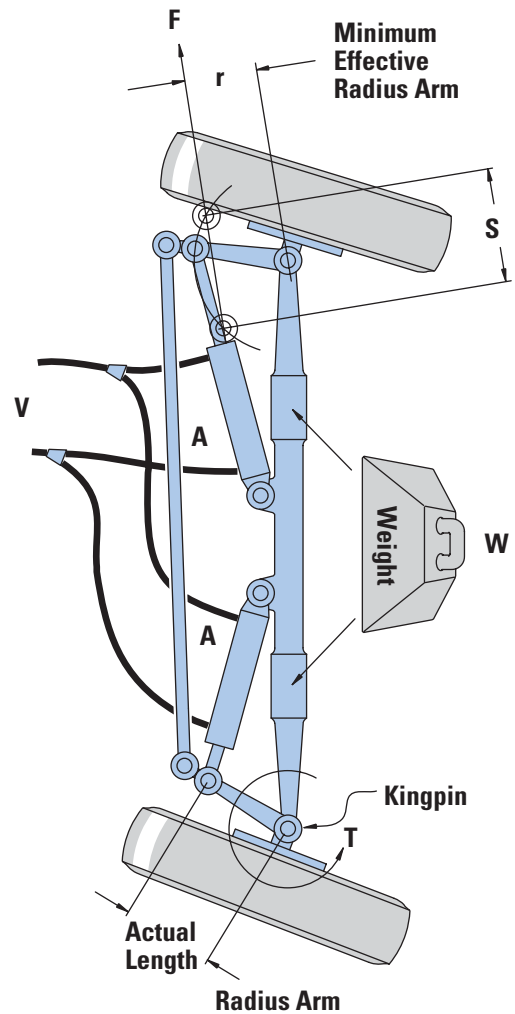
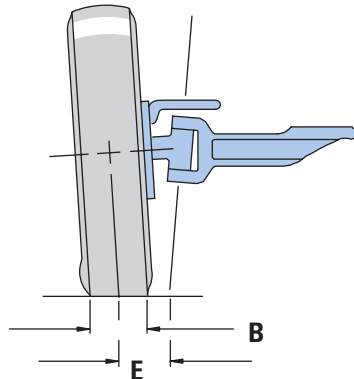
T = Total Kingpin Torque required to steer axle.

W = Vehicle Weight supported by the steered axle.

f = Coefficient of friction (dimensionless). Based on 0.7 as a Maximum. Determine from chart at left.

B = Nominal width of the tire print (see diagram above).

E = Kingpin Eccentric (use nominal tire width).



Sizing and Application

Ackerman Type Steering Continued

Step Two:

Force Required

$$F = \frac{T}{r}$$

F = Force required for the axle.

T = Kingpin torque as determined in Step 1.

The value calculated in Step 1 is the total torque for the axle. If the steered axle is power driven, double this value to approximate the additional dynamic loads.

r = Effective radius arm about the kingpin axis at which the cylinder force is applied. The effective radius is the minimum distance from kingpin to the axis of the cylinder ... not the actual length of the arm.

Cylinder Area

$$A = \frac{F}{P}$$

A = Cylinder area for the axle cylinder set.

F = Force required

P = Hydraulic pressure

For vehicle with a steered axle that can never be overloaded use 80% of the steering circuit relief valve setting. For manually loaded vehicles use 60%. For vehicles that can be severely overloaded use 30%.

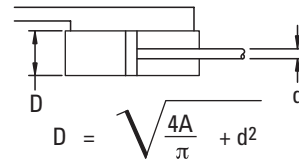
Cylinder Diameter

Once the required cylinder set area is determined, the cylinder diameter can be calculated.

D = Inside diameter of cylinder.

d = Rod diameter as required.

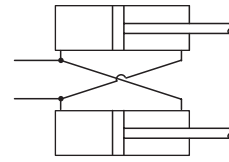
Differential Cylinder



$$D = \sqrt{\frac{4A}{\pi} + d^2}$$

Note: $\left(\frac{d}{D}\right)^2 \leq .15$

Cross Connected Cylinder



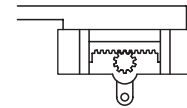
$$D = \sqrt{\frac{2A}{\pi} + \frac{d^2}{2}}$$

Balanced Cylinder



$$D = \sqrt{\frac{4A}{\pi} + d^2}$$

Opposed Cylinder



$$D = \sqrt{\frac{4A}{\pi}}$$

Cylinder Stroke

S = Stroke Length

The cylinder stroke is determined by axle geometry. That is, the required stroke is a function of the radius arm and the total angle through which the arm turns.

Differential Cylinder (Large Volume)

$$V = S \times \frac{\pi}{4} \times D^2$$

Differential Cylinder (Small Volume or Balanced Cylinder)

$$V = S \times \frac{\pi}{4} (D^2 - d^2)$$

Cross Connected Cylinder

$$V = S \times \frac{\pi}{4} (2D^2 - d^2)$$

Cylinder Volume

$$V = \text{Volume} \quad V = S \times A$$

The volume of oil required to move cylinder rod(s) through the entire stroke.

Sizing and Application

Ackerman Type Steering Continued

Step Three:

Selecting Steering Unit Displacement

Before proceeding further, a decision must be made as to the number of steering wheel revolutions desired for the application to steer the axle from full one side to the other. Depending on vehicle usage, this will vary, normally 2 1/2 to 5 1/2 with 4 being a good typical value

$$\text{Displ.} = \frac{V}{N}$$

V = Volume full stroke

N = number of steering wheel revolutions lock to lock

Once this calculation is complete, select the closest standard steering unit displacement from the catalog information.

Now the number of steering wheel revolutions should be recalculated.

$$N = \frac{V}{\text{displ.}}$$

displ. = Steering unit displacement per revolution.

Note: for different cylinder applications, the cylinder volume will be different for right and left turns and the value N will vary accordingly.

Step Four:

Calculating Required Pump Flow

Pump sizing is important to assure adequate power for steering under all operating conditions. The required pump flow can be calculated by the following equation.

$$Q_p = R_{\text{max.}} \times \text{displ.}$$

Q_p (L/min): Required pump flow.

R_{max} = Max. steering wheel input of steering control unit (SCU).

displ. = Displacement of steering control unit per revolution.

Before proceeding to evaluation required pump flow the maximum required steering wheel speed must be determined. Typically 120 revolutions per minute (RPM) is used for R_{max}.

- It is important at engine low idle condition that the maximum steering wheel speed should be more than 60 rpm.
- For engine normal idle condition, maximum steering wheel speed should be more than 100 rpm if possible.
- When using open center SCU connected with pump directly, maximum pump flow should be less than 1.4 times of SCU rated flow. Higher flow into SCU increases pressure-loss of the steering system. If higher flow is unavoidable, install a flow divider valve into the system or use a load sensing system.

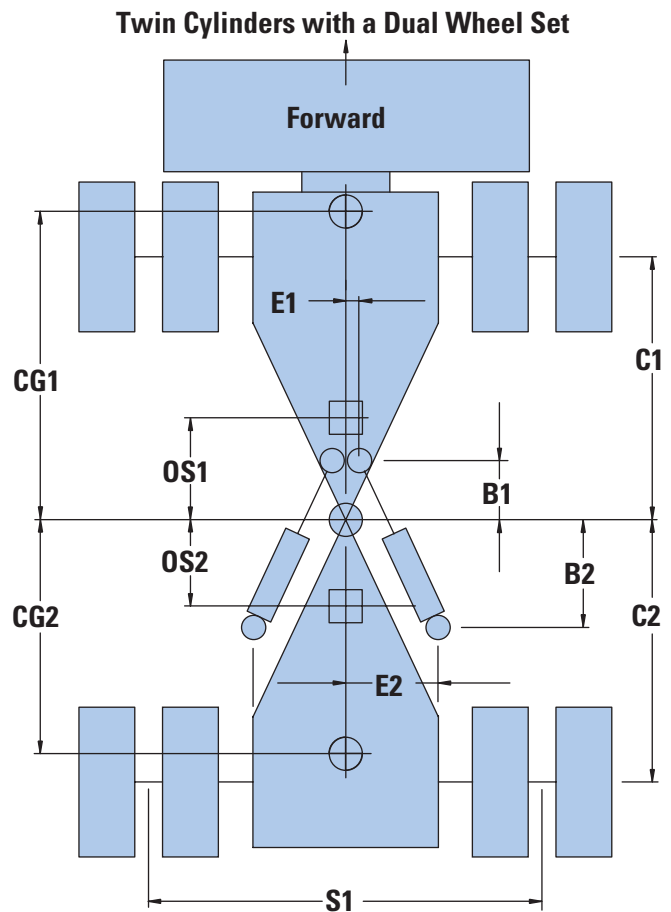
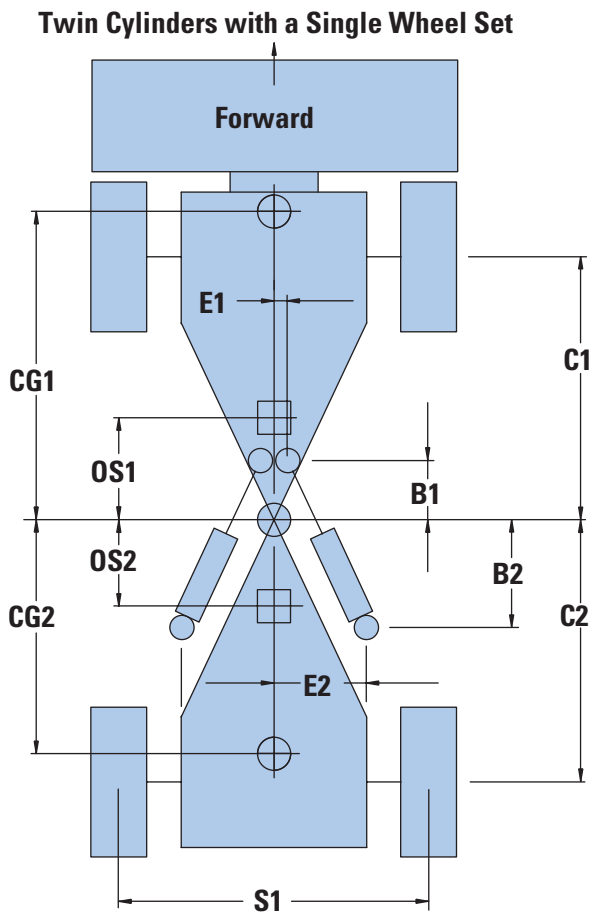
Sizing— Articulated Type Steering

Eaton®'s Hydraulic Division has developed a computer program to assist articulated vehicle designers with a steering system analysis. This analysis can provide basic system sizing, pressure requirements or a complete system analysis including dynamic characteristics.

This analysis is intended to be used as a guide only and is not to be used solely as the final determination of system design. Other factors and variables will have to be considered.

To receive output from this program, provide the required information by using the form on the following page. Contact an Eaton Hydraulics Division Sales Representative or send it to:

Marketing Product Manager—Steering
Eaton Hydraulics
14615 Lone Oak Rd.
Eden Prairie, MN 55344



Sizing— Articulated Vehicle Steering Analysis

Clip out this form or photocopy when needed.

Manufacturer _____

Vehicle Type _____

Model Number _____

Completed By _____ Date _____

Indicate Unit of Measurement Used _____

- | | |
|---|---|
| 1. Turns Lock to Lock _____ | 22. Articulation Angle (lock to lock) _____ |
| 2. Time Lock to Lock _____ | 23. Steering Circuit Line Size, Lengths, Type, Location (please note on schematic ref. 10.) _____ |
| 3. Max. Steering Wheel RPM _____ | 24. Is Steering Through Brakes Statically Required? _____ |
| 4. Cylinder Rod Diameter _____ | 25. Are Locking Differentials Used? Front _____ Rear _____ Both _____ |
| 5. Cylinder Bore Diameter _____ | 26. Is There A Differential Between the Front and Rear Differentials? Yes _____ No _____ |
| 6. Cylinder Stroke _____ | 27. CG1 (Center of Gravity) _____ |
| 7. Pump: GPM Hi Idle _____
GPM Lo Idle _____ | 28. CG2 (Center of Gravity) _____ |
| 8. Steering Relief Pressure _____ | 29. OS1 (Operator Seat) _____ |
| 9. Auxiliary Relief Pressure _____ | 30. OS2 (Operator Seat) _____ |
| 10. Hydraulic Schematic (attach) _____ | 31. Weight - Front Bogey _____ |
| 11. B1 _____ | 32. Weight - Rear Bogey _____ |
| 12. B2 _____ | 33. I1 Mass Moment of Inertia (about CG1) Front _____ |
| 13. C1 _____ | 34. I2 Mass Moment of Inertia (about CG2) Rear _____ |
| 14. C2 _____ | 35. Tire Size _____ Pressure _____
Width _____ Ballast _____ |
| 15. E1 _____ | |
| 16. E2 _____ | |
| 17. S1 _____ | |
| 18. Weight - Front Axle Unloaded _____ | |
| 19. Weight - Rear Axle Unloaded _____ | |
| 20. Weight - Front Axle Loaded _____ | |
| 21. Weight - Rear Axle Loaded _____ | |

NOTE:

- 1-10** Should always be completed; this information is needed for basic steering system sizing.
- 1-26** Needed for sizing and an analysis of steering pressure characteristics.
- 1-35** Needed for a full steering system analysis including dynamic characteristics.

Sizing— Articulated Vehicle Steering Analysis

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| 14. C2 _____ | Width _____ Ballast _____ |
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| 16. E2 _____ | |
| 17. S1 _____ | |
| 18. Weight - Front Axle Unloaded _____ | |
| 19. Weight - Rear Axle Unloaded _____ | |
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Char-Lynn